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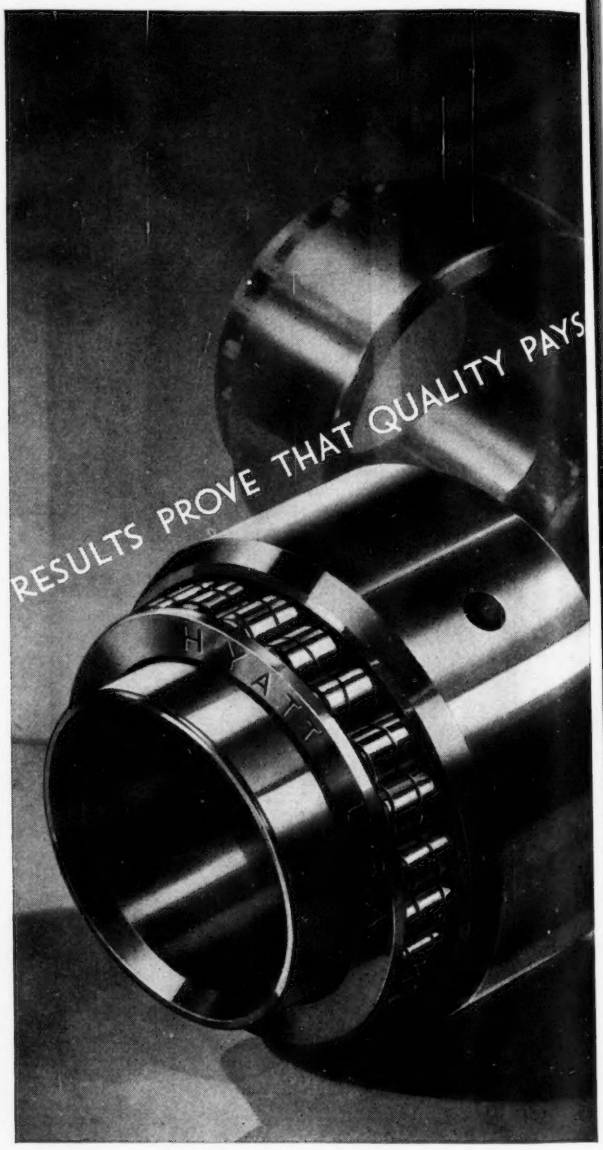

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AGRICULTURAL ENGINEERING

Volume 14 MARCH 1933 Number 3

The Heat Production of Poultry Under Housing Conditions[1]

By Henry Giese[2] and Frank J. McCormick[3]

THE AGRICULTURAL engineer is frequently confronted with the problem of designing poultry houses with wall construction and ventilation which will permit a satisfactory circulation of air and still maintain a predetermined room temperature. Since the artificial heating of poultry houses has not become an accepted practice, the burden of heat production is placed upon the hen. Maintenance of a satisfactory temperature requires a balance between the heat produced within the house and that dissipated through the walls and ventilation system.

Just how much heat can the hen furnish? Does this quantity vary under different environmental conditions, and if so, to what extent? Several years ago an experiment station research project was organized cooperatively among the poultry husbandry, veterinary physiology, agricultural chemistry, and agricultural engineering sections of the Iowa Agricultural Experiment Station to study the air requirements of poultry.

Believing that some of the data gathered in connection with the project may be of some value inasmuch as they relate to the ability of poultry to produce heat under normal or working conditions, they are submitted here.

THE EQUIPMENT USED

The experiments referred to were conducted with a battery of ten airtight pens, which were constructed in two tiers of five pens each. Each pen was 7 ft by 5 ft 6 in in plan and 3 ft 6 in in height. This allowed each bird 3.85 sq ft of floor space as ten White Leghorn birds were confined in each pen.

This battery was entirely inclosed within another building to eliminate the effect of sunlight. Illumination was provided for 12 hr each day by automatically controlled incandescent lamps. The vitamin D deficiency was compensated by feeding codliver oil.

The pen walls were made of two layers of one-half-inch Celotex with a three-eighths-inch intervening air space. The walls and ceilings were lined with galvanized iron, with joints soldered, to prevent the Celotex from becoming water-soaked due to the excessive humidity which prevailed within the pens. An elevation drawing of the pen arrangement, Fig 1, shows the numbering system employed.

[1]Journal Paper No B98 of the Iowa Agricultural Experiment Station. Released for first publication in AGRICULTURAL ENGINEERING.

[2]Professor of agricultural engineering, Iowa State College. Mem. A.S.A.E.

[3]Formerly research assistant in agricultural engineering, Iowa State College.

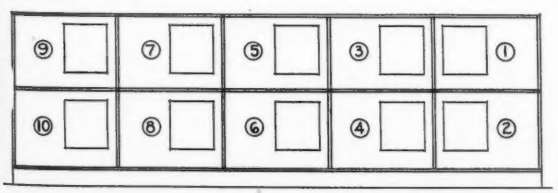


Fig 1. Front elevation of pens showing numbering system

Compartments were added at the ends of the battery adjacent to pens 1 and 2 and 9 and 10 (Fig 2) to enable an attendant to enter the pens without seriously disturbing the air conditions within. After entering the end pen through one of these compartments, communication with the adjacent pen was possible through an airtight door between.

Each of the pens was equipped with identical nests, roosts, dropping boards, feeders, grit hoppers, and water pans. It was possible to add feed and water and to remove the eggs through stoppered pipes and small felt-seal doors with practically no effect on the interior conditions. In the front of each pen a double-glazed window sash was sealed in place to permit observation of the interior. (Fig 3).

AIR SUPPLY OF PENS

For the operation periods considered in this paper the air supply was controlled for only five of the ten pens, the others being open to natural ventilation. The air was supplied to pens numbered 6 to 10 inclusive, through a specially designed electrically driven displacement pump (Fig 4). The quantities supplied each pen in cubic feet per minute were as follows:

Pen number	6	7	8	9	10
Air supply	0.054	0.15	0.70	2.63	9.93

The carbon dioxide determinations were made with a Peterson-Palmquist apparatus modified to permit the analysis of air with a very high CO_2 content, such as encountered in these experiments. Air samples were taken through a long glass tube introduced through a small opening in the front of the pen.

Relative humidity determinations were made with a psychrometer of special design, such that the wet-and-dry bulb temperatures might be read through a two-inch diameter opening in the front of the pen without removing any of the air from the pen.

A thermometer was hung in each pen from which readings were recorded at 8:00 a.m. and 4:00 p.m. daily. The temperature in the surrounding building was also recorded at these hours.

The data used in this report were taken during the two runs of 1928-29 and 1929-30. The records for the 1928-29 run cover a period of 21 weeks from about the first of

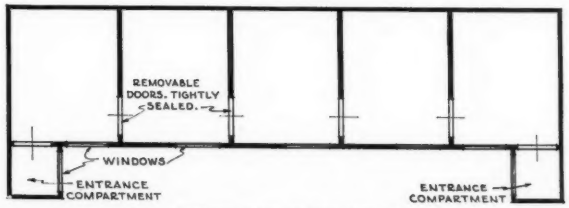


Fig 2. Floor plan of one tier of pens

December 1928 to the first of May 1929. The 1929-30 run covers a period of 19 weeks between the first of January 1930 and the latter part of May 1930.

DETERMINATION OF HEAT EXCHANGE

Because of the lack of detailed data on relative humidity and carbon dioxide, the week was taken as the unit of time, which gave a series of forty observations on each of the five pens under observation. That is, a total of 200 observations is to be treated in the following report.

In determining the heat losses by conduction the following coefficients were used:

Material	Coeff. of internal conductivity	Coeff. of surface conductivity
Celotex	0.33	1.25
Wood	1.00	1.25
Galvanized iron		1.40

Internal conductivity coefficients are expressed in Btu per inch thickness per square foot per hour per degree (F) temperature difference. The surface coefficients are expressed in Btu per square foot per hour per degree (F) temperature difference. The conductivity of double-glazed windows was taken at 0.4 Btu per square foot per hour per degree (F) temperature difference.

Using these figures the heat losses per day (24 h) per square foot per degree temperature difference for the various wall and floor construction shown in Fig 5 are as follows:

1. Double Celotex wall ..... 3.88 Btu
2. Triple Celotex wall ..... 2.61 Btu
3. Wood and Celotex floor ..... 6.28 Btu
   Double-glazed windows ..... 9.60 Btu

The gain or loss from adjacent pens was assumed to be constant and was determined by the average temperature difference between the two pens considered for the entire run.

In all heat measurements the term "outside temperature" refers to the temperature within the building in which the pens were housed, as this was the temperature to which the exterior of the pens was subjected. The outside temperatures used were the weekly averages of the 8:00 a.m. and 4:00 p.m. daily readings.

To determine the heat loss by conduction through the pen walls, the average weekly differences between the pen and the outside temperature was determined. This multiplied by the daily coefficient of conduction for the pen gave the average daily heat loss for the week. To this was added or subtracted the loss or gain from the adjacent pens to determine the net loss of heat by conduction.

In lieu of local relative humidity records the monthly averages given by the U. S. Weather Bureau for Des Moines were used to determine the amount of moisture carried by the intake air. This figure was used to determine the total heat contained in the air supply. Local relative humidity records, unless continuous over the twenty-four hours of the day, would probably have increased the accuracy very little.

Relative humidity values within the pen were available for both runs. As the relative humidity in any one pen for each run was quite constant, the average of all the determinations for that pen for each run was found and this figure used as the relative humidity of that pen for the run considered.

The volume of air introduced daily into each pen was determined from the pump records. The amount of air supplied was converted into pounds by use of Goodenough's Table[4], the temperature and relative humidity being known. It was further assumed that the same weight of air left the pen as entered it; changes in weight due to respiration gases and moisture were neglected. From the tables

[4]Harding, L. A. and Willard, A. C. Mechanical equipment of buildings. Vol II. Heating and Ventilation. Wiley, 1916. p 430.

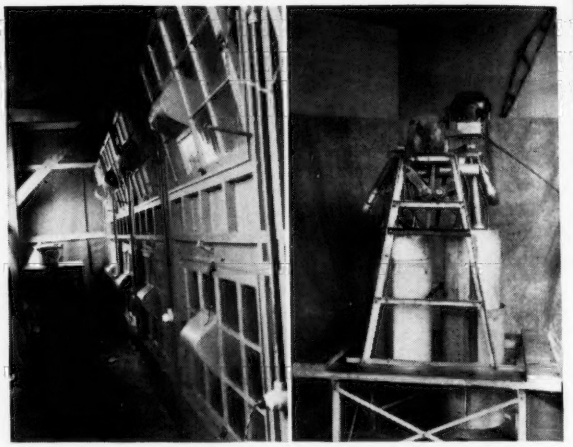


Fig 3. (Left) View showing front of pens. Fig 4. (Right) The air pump that furnished the air supply

mentioned the total heat of the intake air was determined. This total heat included only the sensible heat of the dry air above zero degrees Fahrenheit plus the heat of evaporization of the contained moisture. The sensible heat of the water vapor was disregarded as it was always small in comparison with the total heat.

In the same way the total heat of the exhaust air was determined from its temperature and relative humidity. The difference in heat content of the air at exhaust and intake was considered to be the total heat loss by convection.

The total heat loss by convection added to the net loss by conduction yields the total heat loss per day per pen, as the radiation losses were negligible. Dividing this figure by the number of birds per pen (ten), the average daily heat production per bird was determined for that week. To express this relationship algebraically, let

H_i = heat of incoming air
H_e = heat of exhaust air
H_b = heat added by birds
$H_{cv} = H_e - H_i$ = heat loss by convection
H_{cd} = heat exchange by conduction.

Then the heat produced by the birds is determined from the expression

$$H_b = H_{cv} + H_{cd}$$
$$= H_e - H_i + H_{cd}$$

The daily heat loss per degree (F) temperature difference has been termed the "thermal characteristic" (C) for the pen. This number was found by dividing the total heat loss per bird per day by the difference between the pen and outside temperatures. In other words, C is the coefficient of heat loss per degree temperature difference per bird.

The entire lot of 200 observations was divided into six groups according to the outside temperature. All observations in which the outside temperature was between zero and ten degrees Fahrenheit were placed in one group; those in which the outside temperature was between 11 and 20 degrees were placed in a second group, etc.

Then for each of the observations the daily heat production per bird (H) was plotted against the thermal char-

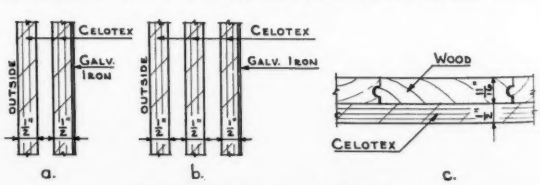


Fig 5. Wall and floor sections

acteristic (C). All observations for one group were plotted on one chart, those for another on a second chart. The curves for two of the groups are shown in Figs 6 and 7. Fig 8 is a composite of all of the six group curves. These curves show a very definite correlation between the heat production and the thermal characteristic, and when the six curves are superimposed, as in Fig 7, a correlation is also observed between heat production and the outside temperature.

CARBON DIOXIDE THERMAL QUOTIENT

Benedict and Carpenter[5,6] in their experiments on the metabolism of man have noted a fairly constant ratio between the amount of carbon dioxide exhaled and the total heat produced. This ratio is known as the carbon dioxide thermal quotient.

From limited data presented by Anderson and Kulp[7] the carbon dioxide thermal quotient for poultry has been computed by the writers. Under the conditions of their experiments a reasonable figure seems to be approximately 36 grams of carbon dioxide per 100 kg-cal of heat produced for White Leghorn birds. This figure is somewhat higher than the 30-gram average found by Benedict for man.

Using this carbon dioxide quotient and the average daily carbon dioxide production per bird, the heat production per bird for each of the five pens was computed. The results for the 1929-30 run are compared with the heat production figures obtained by the previously discussed heat-exchange method in the following table. The carbon dioxide content, expressed in parts per 10,000, is also included as a matter of interest. The figures for the 1928-29 run differ but little from those shown in this table:

Pen No.	CO_2 parts per 10,000	Heat product in Btu per bird per day	
		Computed from CO_2	Computed from losses
6	86	420	410
7	20	232	867
8	11	664	612
9	7	1600	1263
10	2	1080	1442

[5]Benedict, F. G. The influence of inanition on metabolism. Carnegie Inst. Pub. No 77 (1907).

[6]Benedict, F. G. and Carpenter, T. M. The metabolism and energy transformations of healthy man during rest. Carnegie Inst. Pub. No 126. (1910).

[7]Anderson, R. J. and Kulp, W. L. A study of the metabolism and respiratory exchange in poultry during vitamine starvation and polyneuritis. N. Y. Agr. Exp. Sta. Tech. Bul. 88. (1922).

Remarkable agreement is observed in the cases of pens 6 and 8, and the results for pens 9 and 10 are not discouraging. But for the lack of agreement in pen 7 no explanation is offered.

APPLICATIONS OF MATERIAL

Previous experiments by Hinebaugh[8] and others, though not always consistent, indicate that a decrease in the heat required of a bird will not only reduce the feed consumption, but that some energy will be diverted to egg production.

Consider the design of a straw loft poultry house 16-by-16 ft with a clear ceiling height of 7 ft and with singleboarded sidewalls. This house with a total of 256 sq ft might reasonably accommodate 75 birds of a small breed.

Assuming the conductivity (U) of the straw to be 0.33 Btu per inch thickness, the loss per day through the 24-in ceiling covering would be 92 Btu per degree (F) temperature difference. Through the single-boarded sidewalls, for which $U = 0.262$, the heat loss amounts to 2820 Btu per day per degree (F) temperature difference.

Assuming three changes of air per hour, or 72 changes per day, the amount of heat required to raise the temperature of the air one degree is roughly equal to (Volume ÷ 54) = 2400 Btu per day.

Thus the total heat loss per day per degree temperature difference may be estimated at

$$92 + 2820 + 2400 = 5242 \text{ Btu.}$$

The thermal characteristic is then $(5242 \div 75) = 70$.

By adding a one-half-inch lining of ordinary commercial insulation board to the interior of the wall, the conductivity is reduced to about 0.147 and the loss through the walls becomes only 1580 Btu per day. This reduces the total loss from 5242 to 4000 Btu per day, neglecting the reduced convection loss. The thermal coefficient now becomes 53 instead of 70.

Referring to Fig 7 it is found that with an outside temperature of between 31 and 40 deg the daily heat production would be reduced from about 340 kg-cal to 280 kg-cal per bird, a reduction of 60 kg-cal per bird, or a total of

[8]Hinebaugh, T. D. Feeding experiments with chickens. N. D. Exp. Sta. Rep. p 16-18. (1896).

[9]Mitchell, H. H. and Haines, W. T. The basal metabolism of mature chickens and the net-energy value of corn. Jour. Agr. Res. Vol 34, p 942. (1927).

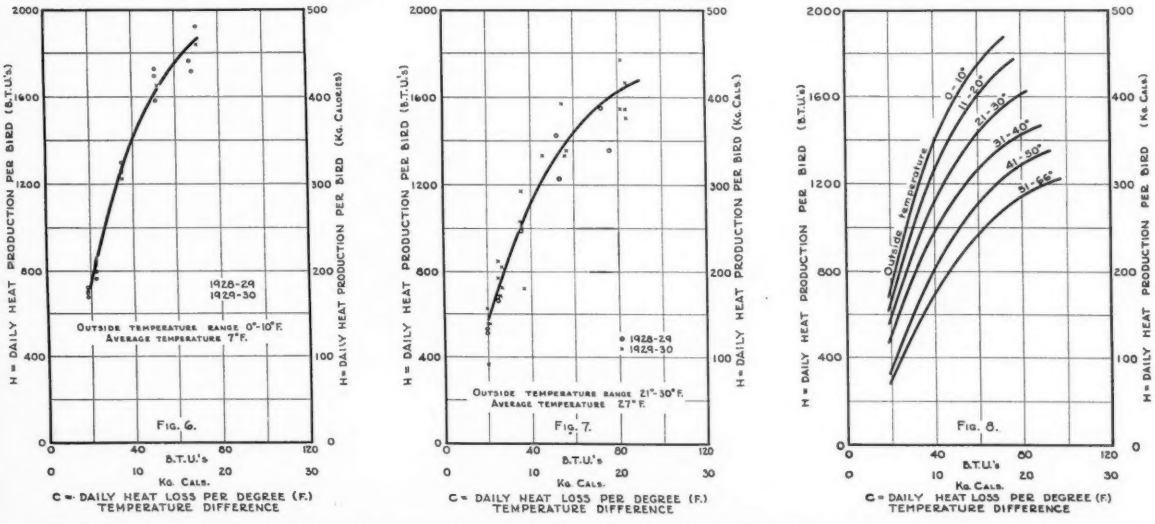

H = DAILY HEAT PRODUCTION PER BIRD (B.T.U.'s)
H= DAILY HEAT PRODUCTION PER BIRD (Kg. CALORIES)
1928-29
1929-30
OUTSIDE TEMPERATURE RANGE 0°-10°F.
AVERAGE TEMPERATURE 7°F.
Fig. 6.
B.T.U.'s
Kg. Cals.
C = DAILY HEAT LOSS PER DEGREE (F.) TEMPERATURE DIFFERENCE
H = DAILY HEAT PRODUCTION PER BIRD (B.T.U.'s)
H= DAILY HEAT PRODUCTION PER BIRD (Kg. Cals.)
1928-29
1929-30
OUTSIDE TEMPERATURE RANGE 21°-30°F.
AVERAGE TEMPERATURE 27°F.
Fig. 7.
B.T.U.'s
Kg. Cals.
C = DAILY HEAT LOSS PER DEGREE (F.) TEMPERATURE DIFFERENCE
H = DAILY HEAT PRODUCTION PER BIRD (B.T.U.'s)
H= DAILY HEAT PRODUCTION PER BIRD (Kg. Cals.)
Outside Temperature
0 - 10°
11 - 20°
21 - 30°
31 - 40°
41 - 50°
51 - 66°
Fig. 8.
B.T.U.'s
Kg. Cals.
C = DAILY HEAT LOSS PER DEGREE (F.) TEMPERATURE DIFFERENCE

Fig 6. (Left) Variation of heat production with thermal characteristic of pen. Temperature range, 0 to 10 degrees. Fig 7. (Middle) Variation of heat production with thermal characteristic of pen. Temperature range, 21 to 30 degrees. Fig 8. (Right) Variation of heat production with thermal characteristic of pen. Temperature range, 0 to 66 degrees, divided into six groups

4500 kg-cal for the flock. According to Mitchell and Haines[9] this represents the heat energy of approximately 3.2 lb of corn.

This example illustrates one possible application of the material presented above. While absolute accuracy cannot be expected, it is believed that good indications of the results may be predicted in many cases.

[9]Mitchell, H. H. and Haines, W. T. The basal metabolism of mature chickens and the net-energy value of corn. Jour. Agr. Res. Vol 34, p 942. (1927).

CONCLUSIONS

The data secured indicates that heat produced by a chicken varies within wide limits, depending upon environmental conditions. More specifically, the heat production is influenced by thermal characteristic (C) of pen or house, and by the outside temperature (t), the heat production increasing with an increase in C or a decrease in t.

It is believed that the thermal characteristic may be closely approximated for any given pen or house, and thus the heat which is required of the birds can be estimated for an outside temperature within the range of the studies.

Protective Coverings for Rammed Earth Walls

By Ralph L. Patty[1]

A RATHER remarkable discovery was made by the agricultural engineering department of the South Dakota State College in connection with protective coverings for pise de terre or rammed earth walls during the past year. It was found that such a wall can not only be painted satisfactorily within three days after the wall is rammed, but that painting at that time is very desirable. In fact, soils that were thought to be totally unfit for pise construction can be used quite satisfactorily when painted very soon after ramming. Two experimental walls rammed outside in the experimental yard on June 28, 1932, were given sizing coats of raw linseed oil on July 1, three days after the walls were rammed, and were given a coat of ordinary outside house paint on July 2. On July 6 they were given a second coat of paint. These walls are standing in perfect condition today as indicated by the accompanying picture taken of them on January 8, 1933. One of these walls was rammed of soil that has proven altogether unfit for use without a covering. It is wall No 2 in the picture, and the soil contains less than 10 per cent of sand. When used without a covering this soil cracks very badly due to the shrinkage stresses as it dries out. The surface then crumbles and weathers away quite rapidly. This is characteristic of practically all soils that are deficient in sand according to the experimental study made of South Dakota soils.

The discovery was made in connection with the study of protective coverings to find out the optimum time for applying them after the wall is rammed. It was supposed that a covering should not be applied to such a wall until the greater part of the moisture had dried out of it. This period will vary with the weather conditions, but in drying weather it would be from six to eight weeks. Consequently, the discovery that the wall not only could be painted satisfactorily with the moisture still in the wall, but that there was a great advantage in painting it at this time, came as a surprise. Whether or not this will be true of other coverings is a question for further study. In all probability the same thing will be found true for all plaster coats.

Since finding out this fact the study is being followed up to find out if the rammed earth surface could be painted sooner than the three days after ramming, and if there would be any additional advantage in doing so. In order to study this and also to find out where the moisture leaves a pise wall that is painted and how it escapes, test blocks of rammed earth are being made and painted on all six sides immediately after ramming. These blocks are then observed for checks and are weighed for loss of moisture at regular intervals.

So far this study has shown that the blocks painted immediately do lose their moisture but at a slower rate. The two unpainted check blocks that mate the two blocks shown in the picture have lost an average of 6.15 of the original 10 per cent of moisture. The two blocks painted immediately have lost 3.45 of the original 10 per cent of moisture. The blocks have been under test for 30 days. The unpainted check blocks lost 75 per cent of this moisture in the first 10 days, while the painted blocks lost only 40 per cent in the same period. A larger number of blocks are to be included in this study later. There seems to be no objection to painting the walls immediately after ramming as indicated so far in this study, and in the case of an unfavorable soil there may be a slight advantage in painting immediately over painting three days after ramming.

Our three years of study of pise construction indicates that a protective covering is advisable for these walls in all cases and that for many soils a covering is absolutely essential. In two seasons out of three there have been driving rains at Brookings that have marred the surface of these test walls in the yard very badly. Walls made from the very best soils have been roughened decidedly. These walls would no doubt stand for many, many years without actual failure, but they will be somewhat unsightly in appearance. On the other hand, walls that are rammed of unfavorable soil and left unprotected have crumbled deeply in the short three years time.

Another important reason for a wall covering is to protect the wall against the action of water that might drip or flow down the side of the wall due to excessively hard rains or defective roof protection. Such water will cut pise walls like a knife, while a covering will protect them from such injury.

Pise construction is not a suitable type for temporary building purposes; there is too much labor and time involved in its use. A study of it is being made in South Dakota largely because of its insulating value. It is hoped that the deposit of moisture and frost can be controlled on the inside of walls of poultry houses and stock barns when built of this material. If this proves to be the case as the study indicates it will be, then pise walls become more valuable than the average wall, and a protective covering for them will be more than justified.

[1]Chairman, department of agricultural engineering, South Dakota State College. Mem. A.S.A.E.

(Left) Weathering of rammed earth walls that were painted three days after ramming. The wall in No 2 test block is made of soil unsuited for pise construction. (Right) An unprotected pise wall (of the same soil as used in the No 2 test block) that has practically failed

Fig 1. Two views of the mower-crusher used in the research studies of hay making at the Kansas Agricultural Experiment Station. The machine is being developed by the John Bean Manufacturing Company

The Mower-Crusher in Hay Making[1]

By Frank. J. Zink[2]

FOR SEVERAL years Kansas investigators have been studying the effect of different methods of handling and curing alfalfa hay upon quality. During a part of the haying season of 1932 a machine known as the "mower-crusher" (Fig 1) was used in connection with this research.

This machine is a new development which is now undergoing a series of tests before it is placed on the market. The cutting is done by means of a standard mower cutter bar, and the mat formed by the cut swath is elevated and passed between two rollers, which are held in contact with each other by means of springs. The rolls are the same length as the cutter bar. One of the rolls is made of steel while the other is of steel covered with rubber. After passing between these rolls the hay is dropped to the ground to dry in the usual manner. Power to drive the rolls of the machine is supplied by means of a power take-off shaft from the tractor. Other features include a reel to aid in elevating the mat of hay up the inclined canvas conveyor. Fiber brushes with short bristles revolve along the entire length of the rolls to keep the rolls brushed clean of adhering leaves or stems.

Several cuttings of alfalfa and one each of sweet clover and soybean hay were made. The rates of drying rolled hay as compared with ordinary mowed hay were studied. The results indicate that the crushing of hay in the field as it is mowed may become a worth-while practice in hay making. Apparatus is needed which will aid in improving the quality of hay under natural curing conditions. There is insufficient control over the drying period, and any method of curing which will shorten the time required will measurably improve the quality of hay.

Hay quality is decreased in field curing conditions by loss of leaves and by bleaching or color loss. Salmon, Swanson, and McCampbell[3] found that, over seven seasons of cuttings including four stages of maturity in each of subsequent crops, an average of 19 per cent of the leaves was lost. This loss was found to vary from 2.3 per cent to as much as 34 per cent. In this study the leaves represented 51:1 per cent of the crop at the tenth bloom stage. It has already been determined that certain methods of mechanical handling will reduce leaf losses. The shattering of leaves is the direct result of the leaves becoming overdry, while the stems of the plant retain moisture in excess of a satisfactory point for safe storage. The shattered leaves may be retained with the original hay and therefore not actually lost. However, a loss of feeding and market quality occurs because the leaves are detached from the stems, giving the hay a stemmy appearance.

In 1931 an investigation was made of the relation of the drying rates of alfalfa leaves and stems, the results of which are shown in Fig 2. It was found under field-curing conditions that, when there was 30 per cent moisture in the hay, the leaves had only 16 per cent, while the stems had 38 per cent. Kiesselback and Anderson[4] under laboratory conditions obtained similar results. They found that first-cutting alfalfa hay of 20 per cent moisture was composed of leaves containing 12 per cent and stems containing 27 per cent moisture.

This relationship of drying rate of leaves and stems will vary with the different cuttings. Kiesselbach and Anderson[4] state that of seven varieties studied at Nebraska the stem diameter variation between varieties was approximately 10 per cent. However, they found that stem diameters of these varieties were 2.97, 2.38, and 1.89 mm for the first, second, and third crops, respectively. Because of this variation of coarseness of stem it is to be expected that crushing and rolling will have a different effect on each of the various crops. With hay other than alfalfa, such as sweet clover and soybean hay, stem diameters are much greater. It is thought that crushing and rolling these hays should have a greater influence on rate of drying than on alfalfa.

The second major quality loss is due to bleaching. Bleaching or color loss is caused by prolonged curing periods necessary to reduce the moisture to a point for safe storage. The longer the period of curing the greater the hazard of exposure to dews or rains. External moisture is considered to be the greatest of the destructive influences on color. There seems to be little data available as to the actual color loss occurring under lengthened periods of curing. However, this loss is quite obvious even to the inexperienced observer.

The first test of the machine was conducted July 14 on second cutting alfalfa at the animal husbandry department farm at Kansas State College. This hay was used for commercial purposes; therefore it was necessary to fit the study of the machine into the usual production program. The crop was well matured and the weather dry and hot. The results of the test are shown in Fig 3, which illustrates the graphical relation of moisture content of the hay in relation to time of day and time elapsed after cutting. The alfalfa was cut at 10:30 a.m., and by 2:30 p.m. the crushed hay had reached a moisture content of 25 per cent, 4 h after cutting. The uncrushed hay did not reach 25 per cent moisture until 9:30 a.m. on the second day, or about 23 h after cutting. The rolling and crushing would

[1]Paper presented at a meeting of the Power and Machinery Division of the American Society of Agricultural Engineers held at The Stevens, Chicago, November 1932.

[2]Associate professor of agricultural engineering, Kansas State College. Mem. A.S.A.E.

[3]Salmon, S. C., Swanson, C. O., and McCampbell, C. W. Experiments Relating to the Time of Cutting Alfalfa. Kansas Agr. Exp. Sta. Tech. Bul. 15. 1925.

[4]Kiesselbach, T. A. and Anderson, A. Alfalfa Investigations. Nebraska Agr. Exp. Sta. Bul. 36. 1926.

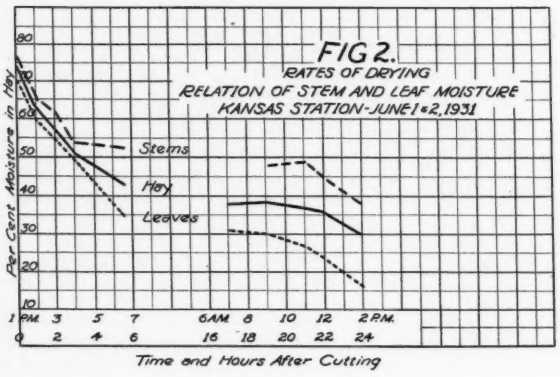
have permitted cutting it in the morning and placing it into storage in the afternoon. It is quite evident that unrolled hay would not have dried in time for handling the same day. The unrolled hay by being out over night was subjected to the hazard of dew moisture and possible rain. The point of 25 per cent moisture in the hay is taken from a statement by Kiesselbach and Anderson[4] in which they conclude, "Hay containing 25 per cent moisture is considered sufficiently dry for placing in the stack or mow." They further state that there are but few data available showing the maximum amount of moisture that alfalfa may contain when placed in storage without subsequent injury.

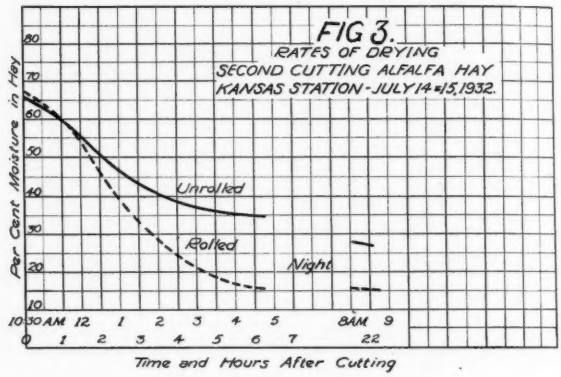
Examination of the fracture of stems of alfalfa hay from crushing showed four distinct longitudinal cracks in each stem. At the cut ends the four segments of the tubular stems warp and spread out. Other stem fractures appear to interlace somewhat diagonally, showing secondary openings. The increased rate of moisture loss is undoubtedly due to evaporation from the interior of the stem by means of air access through the fractured stems. Some of the moisture of the stem due to the compressing action of the rolls is brought to the surface where in contact with air it readily evaporates. The leaves appear to be affected very little by the rolling process.

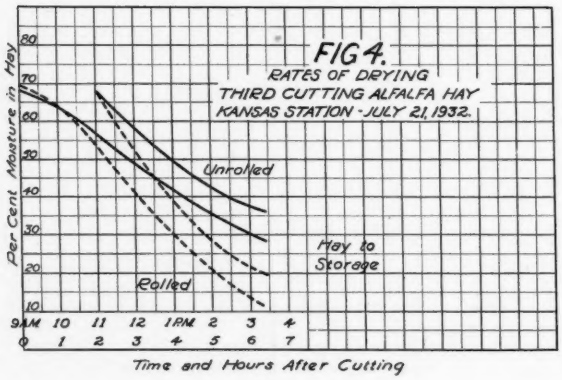
Results with third cutting alfalfa hay are shown in Fig 4. This study was made July 21 with hay on the farm of the dairy department. Mowings were made at 9:00 and 11:00 a.m. In the earlier mowing the crushed hay reached 25 per cent moisture in 4.5 h, or at 1:30 p.m., while the mown hay had reached about 25 per cent in 6.5 h.

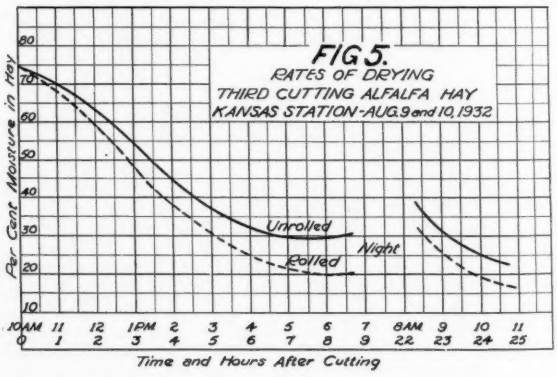
The later mowing shows the crushed hay to have been reduced to about 25 per cent moisture in 3.5 h, whereas the ordinary mown hay in this time had only reached about 40 per cent. This hay went to storage with a rather high-moisture content.

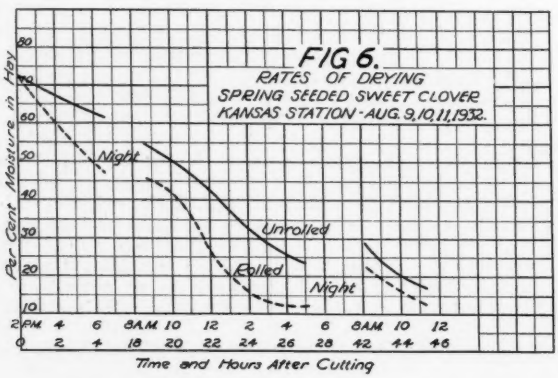
Another test series over alfalfa again using third cutting was made and the results are shown in Fig 5. This crop was very light, having been produced during a rather prolonged dry period, hence the stems were very fine.

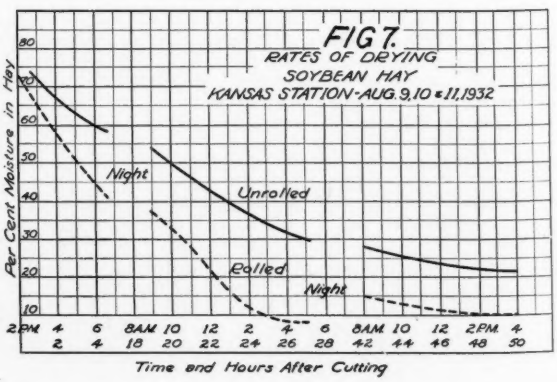












Recent rains had fallen and a high ground moisture condition existed during the curing period. A 0.25-in rain fell during the early morning just previous to this cutting. A mowing was made at 10:00 a.m. In this case the rolled hay had reached 25 per cent moisture in 6 h, or by 4:00 p.m. The unrolled hay did not reach 25 per cent moisture until 10:00 a.m. the second day, or 24 h after cutting.

One of the most difficult hays to cure is sweet clover. Rolling was studied for its effects on the curing rate of spring-seeded sweet clover. This hay was in an early stage of maturity. The results of the test are shown in Fig 6. The mowing was made at 2:00 p.m., and by 6:20 p.m. the rolled hay had lost 26 per cent moisture compared to 11 per cent lost by the unrolled hay. By 12:00 noon the second day the rolled hay had reached 25 per cent moisture. The unrolled hay reached 25 per cent by 4:00 p.m., 4 h later. Because of the rapid drying the first day and the apparently lower loss of moisture during the night time by the rolled material, it would appear that morning cutting would have shown a greater time reduction.

Soybean hay also was processed with the machine. Cutting was done between 2:00 and 2:30 p.m. The rolled hay reached 25 per cent moisture by 11:30 a.m. the following day, about 22 h after cutting (Fig 7). The unrolled hay did not reach 25 per cent until 11:00 a.m. the third day, or 45 h after cutting. The last test on alfalfa and the work on sweet clover and soybean hay was made on crops produced by the department of agronomy. The work of these tests included the dates of August 9, 10, and 11, 1932.

An attempt was made to analyze color loss in handling the third cutting alfalfa hay August 9. Color sampling was done over all stages of curing without significant differences in results. All of the hay would correspond to a market classification of "extra green."

Leaf loss analyses also brought out no important differences in losses due to mechanical treatment. However, neither the color nor leaf loss tests were sufficiently complete to warrant conclusions.

SUMMARY

1. There is apparent a practicable application for the mower-crusher in ordinary haying practice.

2. Under eastern Kansas conditions the rolling process appears to insure a moisture content sufficiently low to permit placing alfalfa hay into storage the same day that it is cut.

3. The rolling process increases the drying rate by stem bleeding and by increased evaporation through the stem fractures.

4. The process provides for a more equal drying rate of leaves and stems and should prevent leaf losses which are due to the leaves becoming overdry.

AUTHOR'S NOTE: Acknowledgment is hereby made of the assistance given by F. C. Fenton, C. D. Davis, and C. A. Logan in furnishing the data presented in Fig 3.

Making Threshing a Two-Man Job

By R. G. Harvey[1]

ONE of the farm jobs that is looked upon as an unpleasant task is that of threshing, not that it takes so long in actual time, but especially because of the dust that is stirred up and the extra labor involved. Therefore last season, as a result of the expressed desire of W. H. Kinney, a farmer near Syracuse, New York, to make threshing a more pleasant job, the writer cooperated with Mr. Kinney to see what could be accomplished in this direction.

A blower was placed in his barn with a 6-in pipe hooked up to a hopper at the threshing machine 132 ft away. The grain dropped into the hopper and was sucked through to the blower and forced up into the grain bins on the next floor. The pipe was made airtight at the joints with heavy rubber bands. The blower was equipped with a 4-in pulley and was driven by a 3-hp electric motor, which had a 10-in pulley, thus giving a blower speed of around 3600 rpm. The 6-in pipe which connected the blower to the hopper, cost 11 cents per foot; the elbows cost $1.00 each. The rubber bands which reinforced the joints were from inner tubes of rubber tires, which worked out very satisfactorily. The main thing that had to be kept in mind was to keep the pipe airtight from the hopper to the blower. This outfit took care of about 2 bu of grain per minute.

The grain bins on this farm are so constructed that, in case the grain is damp or starts to heat, it can be circulated by dropping it into the hopper and forcing it back into the bins, thus getting the desired drying effect.

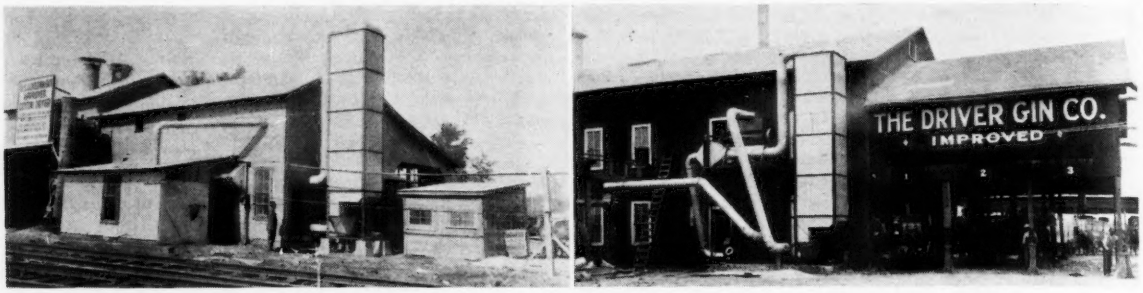
One outstanding feature about this installation is the fact that it cuts down extra labor, as only one extra man is needed. This is a tremendous saving not only in labor outside, but also in the extra work in the house of preparing meals for so many as was the case before this labor-saving installation was made.

Mr. Kinney has it so arranged that all the grain for his livestock can be ground by letting the grain drop into a feed grinder from the bins. The grinder is operated by a 3-hp electric motor. The ground feed is elevated into a bin, from which the feed drops into the cow stable in front of the cows. This enables the owner to have ground feed for his stock, without manual labor, from the time it leaves the threshing machine until it reaches the stock.

Mr. Kinney uses this same motor for many other things, such as sawing wood and hoisting hay, and also in the farm shop and in many other useful places about the farm.

[1]Rural service department, Syracuse Lighting Company. Affil. A.S.A.E.

(Left) View of Mr. W. H. Kinney's thresher in operation, showing hopper and pipe for blowing thresher grain into the bin. (Right) This shows the installation of blower, electric motor, and feed grinder in Mr. Kinney's barn



Two views of the vertical cotton drier developed by the Bureau of Agricultural Engineering, U. S. Department of Agriculture. The one on the left is at Newhardt, Arkansas, and the one on the right at Osceola, Arkansas

Recent Cotton Ginning Investigations[1]

By Charles A. Bennett[2]

A YEAR AGO at your meeting I discussed the drying and preparing of seed cotton for better ginning. A season has now intervened, and studies and tests have been continued, many of which should be carried over a cycle of years to ascertain what characteristics of the seed cotton in all sections of the country may be more or less permanent, and to eliminate those special characteristics which may arise only under abnormal climatic conditions.

Our previous observations seem to have again been definitely confirmed in that the seasonal pickings of the cotton crop are accompanied by distinct deterioration in the seed cotton as the season advances; and that the early, mid-season and late-season pickings each present their own ginning problems. The early so-called "green" cottons may become the cream of the crop, if given the necessary curing or drying, and if carefully handled thereafter to prevent damage. Such pickings can only be harvested satisfactorily, at present, by hand picking and must be kept clean. Mid-season cottons may or may not incur deterioration during their exposure in the fields, but as a rule they comprise the bulk of the normal crop and are harvested by both hand and machinery. The late-season pickings may be anything from rain-soaked open cottons to tough-hulled bollies. The late cottons come to the ginneries with so much trash and under such adverse conditions of moisture content as to be very difficult to gin.

Efforts should be made in ginning the early and mid-season pickings to preserve the length of staple and to conserve the highest possible grade of the ginned lint; careful, clean picking and a minimum amount of mechanical handling are also necessary if the maximum qualities are to be obtained. It is worth while to again emphasize the importance of these correct methods of harvesting, and the necessity of bringing the cotton to the ginnery in a good, clean condition. Unless such precautions are observed, particularly in the case of long-staple cottons, it is impossible for the ginneries to turn out a good product.

There is no reason why we should not regard the industry of ginning cotton in the same light as we do other manufacturing industries. We carry the raw product through various processes, and we deliver the outgoing product to others to finish or not as their respective trade demands may require. If we receive an incoming raw product which does not possess first-class characteristics to begin with, neither a cotton ginnery nor any other factory can deliver a product which is truly of the highest grade. Thus we find it impossible to produce ginned lint of superior grade and preparation unless the seed cotton embodies those inherent quality characteristics at the start and on its arrival at the gin. If the methods of picking lower these qualities, or if the advancing season produces deterioration, the loss cannot be completely regained. Hence, we contend that no ginner can make "middling fair" cotton merely by setting his machinery at a predetermined point, if the seed cotton itself is not fully capable of making "middling fair" lint. Such seed cotton must be ginnable, cleanable, dry, and correctly harvested in all respects.

During the past season we divided our seed cottons into these three principal groups of seasonal pickings. Representative samples were secured from North Carolina, South Carolina, Georgia, Alabama, Tennessee, Arkansas, Louisiana, Oklahoma, Texas, and Mississippi.

As we shall take up some of these tests later on, we may mention that our observations have not been entirely confined to our own laboratory, but have included studies at adjacent gins and trips to special places where problems of interest were arising. Among other things, we were interested in comparing the results produced by cotton gins made between 1912 and 1928 with the more recent ones made from 1928 to 1932, because about the year 1928 there was a general move to make the cotton gins of all-steel construction and to improve the types of ribs, extractors, and other mechanical accessories, with a view to greater permanence in construction and more flexibility in meeting conditions of the crop.

We have noticed that, when equipped with extractors, some of the double-rib gins made between 1912 and 1928 appeared to give better results when the outer ribs were eliminated by feeding directly into the seed-roll box, thereby using the outfit as a plain single-rib design of gin. From time to time, in the older double-rib gins, a roughness and nappiness in the ginned lint has been encountered which was probably caused by "preginning," or untimely removal of the lint in the spaces of the huller front. When this "preginning" occurs, the lint is harshly pulled through the revolving seed roll by the gin saw and is then cast off in a badly kinked and napped condition. The huller gins which appeared on the market in 1928 have embodied new types of huller ribs which tend to prevent such damage.

The earliest of saw gins were of the plain single-rib type, and this design is still popular because of its simplicity, speed of ginning, and low power consumption. So far as we know the double-rib gin was first completely brought out by Ellis of Prattville, Alabama, in the year 1889; and this gin grew in popularity because the huller front afforded the then only existing means of cleaning trashy cotton prior to the advent of extractors. With the adoption of extractors, or special machines ahead of the gin-stand, the burs and foreign matter are successfully

[1]Paper presented at a meeting of the Southern Section of the American Society of Agricultural Engineers, at New Orleans, Louisiana, February 1 to 3, 1933.

[2]Engineer in charge of cotton ginning investigations, Bureau of Agricultural Engineering, U. S. Department of Agriculture. Mem. A.S.A.E.

removed so that the gin saws are well protected, and the need for double-rib huller designs is not so urgent.

The importance of determining the relative merits of plain single-rib gins and double-rib huller gins is apparent to both the manufacturers and to those public ginners who depend upon quantity production to make a profit. If the manufacturer may supply his patrons with plain gins in combination with suitable cleaning and extracting units, everybody benefits since the manufacturer is enabled to make a much simpler cotton gin, and the customer is enabled to gin more cotton per day with less power. It is necessary, however, to point out that we allude only to plain single-rib gins and not to single-rib huller gins, as huller gins of the single-rib type are in an entirely different category and are awaiting investigation at a later date.

A preliminary review of our tests on plain single-rib gins versus double-rib huller gins may be of interest to you. Each of the gins was equipped with a plain front and a huller front, whereby we could convert them into either single-rib or double-rib gins as desired. We first used green, damp seed cotton at various saw speeds; then dried this same seed cotton in the government vertical drier[3] and again repeated the tests; then stored the seed cotton until well cured, and so on. We used both 70-saw airblast and brush types of gins in these studies. It may be necessary to modify some of our conclusions when the tests in their entirety shall have been finished, but from data thus far secured the plain single-rib gins produced virtually the same grade as the double-rib huller gins did, with slight variations each way in one or two instances. The staple length was not affected. Smoothness of ginning was in favor of the airblast double-rib huller gin over the airblast plain single-rib gin, when the seed-cotton had been artificially dried, but on similar tests with the brush gin there was no difference noted.

It would appear from the results of such tests as these that there is ample foundation for the use of the plain single-rib gin in many localities and especially for the longer staples, where the cleaning and extracting is performed prior to the actual ginning. In fact, our own experience in the federal cotton ginning laboratory has been that many of our best ginned special samples have been obtained from our 20-saw, plain-rib brush gin, and we are inclined to feel that the standard number of saws could produce equally good results.

NEXT WILL COME STUDIES OF ACTION WITHIN THE GIN

As we progress in our ginning investigations, we are gradually clearing the way for the intensive study of the action within the gins, our initial studies having been necessary in order to determine the various effects of machinery ahead of the gins so that no incorrect interpretation would result.

Neither time nor space will permit me to describe many of these studies, but I would like to refer to an interesting series of tests which Mr. Gerdes will discuss more fully in his paper from the fiber technology viewpoint.

Short staple cotton was obtained from Texas under four methods of harvesting, beginning with hand picking and stopping with machine stripping. As the roughness of the cotton increased, due to the method of harvesting, it became increasingly necessary to use more and more complicated cleaning and extracting machinery before the cotton could be ginned satisfactorily. We utilized 70-saw, double-rib airblast and brush types of cotton gins in this series of tests, the two types having different kinds of picker rolls, but otherwise being generally comparable.

Operating conditions were visibly much better when a loose seed roll was maintained, and the ginning difficulties noticeably increased as the roughness of the incoming seed cotton became greater. Although we made use of our most complicated machinery combinations with the hand-picked cotton, as well as with the sledded and machine-stripped cottons, we did not observe damage arising therefrom. Our tests showed that no complicated set-up was required to produce a well-ginned, hand-picked cotton, but that every bit of the cleaning and extracting apparatus we had was of use when we encountered the machine-stripped and sledded lots. Mechanical operation of the brush gin on these tests necessitated a continuous dumping of hulls from the huller front on the rough cottons, and as this dumping could not be effectively done on our air-blast gin, there is probably a resulting difference which may be traced back to this picker roll and huller front action.

Last year we discussed the necessity for properly preparing the seed cotton before ginning it. During the past season we have received the hearty cooperation of various manufacturers of cotton-ginning machinery with the result that there is now quite a number of well-built, all-steel drying installations in Arkansas, Tennessee, Kentucky, Mississippi, and Texas. Homebuilt cotton driers of our approved design have been erected as far east as Alabama, and indications are good for increased use of them.

MANUFACTURERS BEGINNING TO BUILD VERTICAL DRIERS

There are now a number of well known manufacturers entering this field, and the widespread interest in these vertical driers has been very gratifying. In a recent visit which we made to some of these driers in northern Arkansas and Kentucky, we witnessed the drying and ginning of some damp seed cotton which had been frozen to the wagon bed so that it had to be actually shoveled into the sucker pipe. A normal rate of ginning was obtained by the use of the vertical drier, and the entire load of cotton was made marketable, whereas it would have been virtually worthless if the drier had not been available.

Concurrently with our other investigations we have had an opportunity during the past year to observe the effects of our vertical drier when operating at different ranges of temperature. Three temperatures were selected for the tests, namely, 150 deg F, 200 deg and 250 deg. Where ample volumes of air and adequate exposures were obtained, the lower temperatures gave most beneficial results without affecting elements of staple length or quality.

Higher temperatures tend to an apparent shortening of the staple, in so far as the cotton classers have reported, and our warnings on this have been confirmed so continuously that the ginners and manufacturers are endeavoring to keep safely within the temperature limits set by the U.S.D.A. Bureaus of Agricultural Engineering and Agricultural Economics. However, a shortening of the staple has been observed after the storing of green, damp seed cotton, which indicates that the driers are not the only source from which a shortening of staple may arise.

It is interesting to know that during the past year we have received a still more pronounced reflection of the importance of dry cotton and the necessity of maintaining a loose seed roll during the ginning operation, and that indications exist which lead us to important studies of the volume of the roll box and its features. Some of our tests have included mechanical turning of the roll by means of various devices, but reports upon these are not yet completed. We have made these tests so that positive roll drives versus plain rolls will afford a means of comparing the effects of each upon the same cottons. Some types of positive seed roll drives increase the rate of turnout, but we are not in a position to report completely upon our own tests, pending fiber studies and classifications now under way.

Among interesting tests on which we are now working up data, we might mention those where we combined good gin saws with poor ribs, poor gin saws with good ribs, good saws with good ribs, and finally poor saws with poor ribs. We have also made interesting layouts using saw teeth of differing degrees of fineness, and have worked out satisfactory methods for ginning very small lots of cotton on either saw or roller gins.

[3]The vertical cotton drier developed by the Bureau of Agricultural Engineering, U. S. Department of Agriculture.

Our roller ginning work has carried us into the irrigated and quarantined sections of the Southwest. At Sacaton, Arizona, we ginned some of the 1⅝-in Pima cotton grown under federal government supervision at the government agency of the Pima Indians. Roller ginning is much slower than saw ginning, the lint being removed from the cotton seed by means of walrus-hide rollers, and the appearance of the lint thus removed being quite different from that produced at saw gins. Our attempts to use a special saw gin on this long-staple Pima cotton were not successful, but we feel that we did make gratifying progress upon some special attachments which offer a means for faster roller ginning without so-called "backlash" troubles, which are now quite common. Such difficulties occur when the long fiber tends to ride back around the roller of the roller gin and become mangled and broken by the knives of the machine.

Fiber laboratory studies and classifications have not been completed on the comparison of roller ginning versus saw ginning on the several cottons we have used during the past year, but we are ginning a portion of each kind of cotton on the roller gin so that we may obtain a reflection from each distinct cotton variety for both principal kinds of ginning.

Sufficient quantities of cotton, ginned during each important test have been reserved for spinning tests, both with the saw and roller gins, and we hope to obtain added valuable information from these bales.

The Kentucky Standard Milk House[1]

By James B. Kelley[2]

THE KENTUCKY standard two-room milk house is 12 feet wide and 14 feet long. One room is used for handling and storing milk, and the other for washing and disinfecting the milk utensils. This is the minimum size of house recommended for producing grades A and B milk, and is large enough for handling, cooling, and storing from 40 to 60 gal of milk in 10-gal cans. The size of the house to build depends upon production of the herd. The width of the milk room and length of the cooling tank should be increased 2 ft 2 in for each additional two cans of milk to be stored.

The concrete foundation is 8 in thick and must extend at least 12 in above the floor. The floor is made of impervious concrete, properly graded to a floor drain.

The walls of the house may be constructed of lumber or masonry. Where frame construction is used, to provide sanitation, appearance and comfort, it is recommended that the walls and ceiling be double-sheathed throughout, but the state board of health permits single-sheathed construction under the following conditions: "The milk room is not required to be ceiled overhead unless flies cannot otherwise be kept out, as in the case of corrugated metal roofing, or unless the roof construction is such that the underside cannot be kept easily clean and free from cobwebs. The inside walls of the milk room may be approved unsheathed, provided the inside surfaces of the outer sheathing and all framing surfaces are smooth, dressed, and painted. This applies also to partitions.

To provide ample light and ventilation there are three single-sash windows, each having six 8-by-12-in panes in the milk room and two in the wash room. A ventilator louvre is placed at each end of the building. All window and door openings are screened.

When preparing the plans of the milk house an attempt was made to provide an inexpensive plumbing system that would meet the requirements of the state plumbing code. Several conferences were held with members of the state board of health before a satisfactory system was designed. The cost of the plumbing was reduced by designing the system so as to use only one vent stack; one trap for the double sink and one floor drain for the two rooms. The floor trap is in the wash room, and the milk room floor is sloped to drain into the same trap through a screened opening in the partition wall between the rooms. The floor and sink drains are connected to a solids interceptor at the rear of the house.

When water is circulated through the cooling tank as the cooling medium, the drain pipe from the tank may be connected to a stock tank, but if ice or mechanical refrigeration is used, the tank drain should be connected to a solids interceptor.

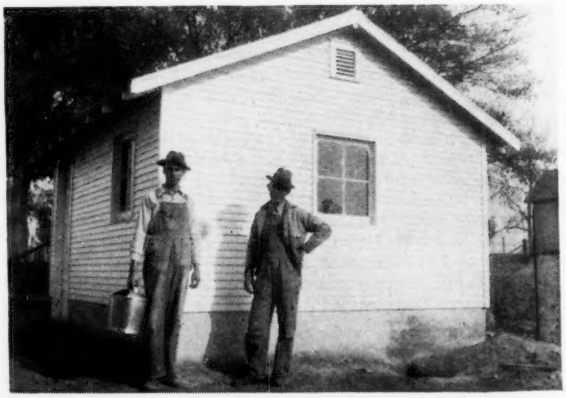
The standard cooling tank for our 12-by-14-ft milk house is 40 in wide, 46 in long, and approximately 26 in deep (inside dimensions), providing storage space for six 10-gal cans of milk when using circulated water as a cooling medium or for four 10-gal cans when using ice or a mechanical refrigeration unit. Any style of commercial refrigeration unit may be used.

It is recommended that the walls and floor of the cooling tank be insulated with a waterproofed material of an insulating value equivalent to 3 in of cork. The outside concrete walls of the tank are 4 in thick and the inside walls 3 in thick. The lid is constructed of a one-in layer of dressed and matched lumber, a layer of insulating material equivalent to 2 in of cork and a layer of 26 gage galvanized sheet metal.

In the milk room, a drying rack constructed of ¾-in galvanized pipe is provided for the milk cans and utensils. A double-apartment sink is recommended for the wash room.

So many different types of water-heating and sterilizing equipment are available for the dairy that no attempt was made to show installation details on the plans, except to suggest the location of the equipment in the wash room. Most of the dairymen in the Louisville milkshed heat the wash water in the sink by means of an oil or gas burner mounted beneath it. They sterilize the utensils with chemicals after they are washed.

EDITOR'S NOTE: A set of blueprints of the Kentucky two-room milk house, showing plans, details of construction, and specifications, may be purchased at a cost of 20 cents a set direct from the Department of Agricultural Engineering, University of Kentucky, Lexington.



This is one of the Kentucky standard two-room milk houses. It was built at a total cost of $178.00

[1]Abstract of a paper presented at a meeting of the Structures Division of the American Society of Agricultural Engineers held at The Stevens, Chicago, November 1932

[2]Professor of agricultural engineering, University of Kentucky. Mem. A.S.A.E.

Valve Problems and Recent Developments[1]

By A. T. Colwell[2]

THE conditions affecting the performance and servicing of valves and other motor parts in tractor engines vary considerably from automobile and airplane practice. The tractor engine with governor ordinarily operates at comparatively low speed, but at full power and for long periods. Automobile engines now run well over 3000 rpm, but ordinarily not for long periods. The passenger car driver constantly is looking for new engine noises, real or imaginary, and is usually prompt in having trouble corrected. When engines become sluggish and acceleration disappears, the average driver corrects the condition.

The tractor operator is not troubled greatly by engine noise, and too often will run his engine long after danger signs have appeared. Loss of power is not so important if the engine still operates, and if a job must be finished without delay, the engine is continued in use. This accounts for the fact that, when tractor engines are repaired, much more work is necessary than on automobile engines, and parts may be in very bad condition.

The automobile operator seldom does his own work, his engine being repaired by some trustworthy shop. The tractor operator, on the other hand, is more likely to do his own work, and being unskilled in such work a satisfactory job is unlikely. He does his own work to be economical, but very often it proves the expensive way. The skilled service man knows what parts should be replaced and how to do the work. He knows fits, tolerances, methods, and materials; that is his business. His work is backed by his organization, and must be satisfactory to the tractor owner. One of the finest points any organization can sell with their tractors is the fact that service work should be done by competent workmen, and not by the tinkerer. The latter in most cases is the more expensive.

Valves in tractor engines give much the same troubles that are common in automobile and truck engines. Because of lower operating speeds, breakage is less frequent, but pitting, so-called warping, scaling, wear, stretching, and sticking are likely to be found. Fuel used is often lower in grade, and many evils can be traced to poor fuel. Highly cracked fuels are likely to be high in gum content. If the engine is used continuously, the effect of such fuel may not be noticeable, but if it stands idle for one to three weeks, a serious condition may be found. Valves may be stuck so that it is necessary to pry or hammer them out. Rings may be frozen in their grooves.

If this type of fuel is used, a good precaution is to use a top cylinder oil in the gas. Some of these oils are prepared to act on gum, and tests have shown some types highly beneficial. Good oils of this type are beneficial in lowering friction, preventing valve sticking, lowering cylinder deposits, and decreasing exhaust valve temperature. These oils are coming into more general use.

When valves are reground certain facts are important. If valves are refaced, the chuck used should be reasonably accurate. Too often a good valve will be made worse when a poor chuck is used. If the new valves are not installed, the old valves should be refaced to give best results. We recommend the use of new valves instead of repairing old ones, because long periods of high heat and pounding on the block alter the metallurgical structure of the steel, and regrinding is necessary more frequently as valves age.

When new valves are installed, never put them in a chuck for refacing. Factory equipment is accurate and the valves will be worse after refacing.

Often the tinkerer will use a coarse grade of emery for grinding valves, without washing the block afterward. Tools may be obsolete or unfit for the job. Valve and block may be refaced and valves installed without grinding. This is not recommended, as a satisfactory job without grinding can only be done with precise factory equipment for holding concentricity.

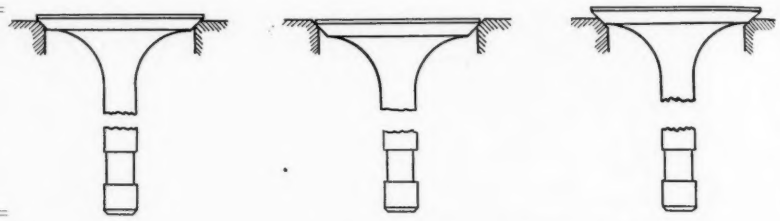
If the block seat has been cut too much, or is pounded, the unskilled man does not know how to handle the work properly. The old valve may be installed, dropping too far into the block. This changes engine timing, often causes block pounding, will cause the exhaust valve to overheat due to wire drawing, and on the intake side causes a loss in volumetric efficiency.

An oversize valve may be installed which is too large for the port, seating only part way down the block seat. In this case, the seating area is greatly decreased, a ridge will soon pound in the block and the exhaust valve will run hotter because of the large amount of head extending into the combustion chamber and the decreased seat area

[1]Paper presented at a meeting of the Power and Machinery Division of the American Society of Agricultural Engineers held at The Stevens, Chicago, November 1932.

[2]Chief engineer, Thompson Products, Inc.

Progress is being made in development work on valves for farm tractor engines, as well as other automotive engines. This is proceeding along two lines, namely, to improve the performance of steels now known, and to develop other steels. No one steel has all the requirements of a perfect valve steel, although these requirements can be found individually in different steels



(Right) This sketch shows a valve properly seated in the engine block. (Middle right) The valve in this drawing is seated too far into the block. (Extreme right) In this sketch the valve is not seated far enough into the block

for heat transfer. In either of the above cases, the repair work must soon be done again, and skilled work in the first place would have been economical.

Again, valve trouble may be due to some other condition which the skilled man will detect. If guides are worn, sloppy, and bell-mouthed, it is impossible to do a good valve job. If the block seat is cut with the pilot in such a guide, it is concentric with the guide only, with the pilot in the cutting position. The pilot will take different positions if taken out and reinserted, and an indicator will not give the same reading in any two positions. Valve guides should be replaced if they show wear and excessive clearance. Sloppy guides cut down heat transfer from the exhaust valve stem, allow excessive oil on the valve and, consequently, carbon to cause valve sticking, and allow the valve to clatter and pound the block seat. This clattering is responsible for much valve breakage, as terrific stresses are set up under the valve head. Many valves are also broken at the retainer neck due to this action.

In tractor operation there should never be a valve failure from lashing if the engine functions properly. Noise is not as critical as with the automobile driver. If the tappets can be heard, this noise is insurance against valve burning. Tappet clearance should be checked from time to time, as blocks may pound or valves stretch, taking up tappet clearance and allowing the valve to ride. If it is found that certain valves are continually losing clearance, this indicates that trouble is on the way and the head should be pulled.

If the block is pounding, check the cooling system, as deposits may have formed preventing proper water circulation. The mixture used may be very lean, this having a detrimental effect on exhaust valves and block seats. The installation of a good seat insert in the block will prevent further pounding. We recommend the hardened type as most satisfactory. The seat should be installed with a press fit of 0.003 to 0.005 in, if the seat expansion coefficient is near that of the block. The iron of the block should then be peened into place about the top outer edge of the ring to hold it in place. Good seat inserts are metallurgically stable at engine operating temperature, and add greatly to valve life. With proper tools the installation of seat inserts is quite simple. They must be ground after installation to assure concentricity with the guide. Valve regrinding is less frequent when a hardened insert is used. In some cases rings are chilled or blocks heated to give a better fit. If rings are being installed in two exhaust ports, side by side, they should be drifted in at the same time, to prevent distortion of the narrow block between the two seats. If inserts are loose in position, valves will run much hotter due to poor heat transfer.

INSTRUCTIONS FOR INSTALLING A VALVE SEAT INSERT

To install a seat insert, first check the guide for wear. If it should be replaced, do so by drifting the guide out toward the combustion chamber when possible. That portion of the guide in contact with exhaust gases is likely to be scaled and enlarged, and will mar the head if drifted away from the combustion chamber. Install the new guide. Ream guide to allow approximately 0.001 in clearance for each 0.100 in of valve stem diameter. Carefully install pilot in the new guide, and bore a recess in the head to give a press fit of 0.003 to 0.005 in. Bore depth to bring ring flush with the block surface, making the bottom of the recess smooth.

Drift the ring into place with a tool for this purpose, or with a small block of wood. Just before the ring seats, about 1/16 in, blow out chips and dirt from bottom of recess. Then seat ring, and peen or roll iron of the block over top outer diameter of the ring. Hardened seats have the seat already ground. Touch seat with grinder to bring it concentric with the guide within 0.001 in. Grinders having a wheel eccentric with its pilot are now on the market for this work, and are very accurate. Lap valves to the seats with a fine compound, using very little pressure, being sure the valve extends below the lower edge of the seat. Otherwise, the valve will give trouble as soon as the guide wears. Thoroughly clean all traces of compound from the block and valves.

Check the valve springs. Under heat and continued use they may lose strength, allowing the valves to be thrown from the cam, causing a rough engine, and aggravating valve troubles. This is one of the principal causes of valve breakage. If springs are weak by 20 per cent, they should be replaced.

Valves with worn retainer necks should not be reinstalled. Locks and caps should be inspected for a good fit, following which the valve installation may be finished. Care should be exercised in drawing down the cylinder head evenly and gradually, as valves can be badly unseated if this is not properly done.

Air cleaners are particularly important on tractor engines. We have seen valves with seats worn to a knife edge at the top from dirt. These valves had a heavy deposit which an analysis proved to be dirt in silicon. The valves were ruined and other engine parts must have been badly worn. On tractor engines the cleaners should be attended to 600 to 800 times as often as on automobile engines.

LOSSES CAUSED BY EXCESSIVELY HOT EXHAUST VALVES

The hottest spot in the combustion chamber is the center of the exhaust valve head. Excessively hot exhaust valves cause a loss in volumetric efficiency, detonation, and possibly preignition. The valve can lose heat only through the seat and guide. It is, therefore, good design to bring ample water as close as practical to the block seat, and to provide good cooling for the guide. In this connection, guide length is not the controlling factor in guide cooling. It is the bearing area of the guide in the block, and very short bearing areas cut down cooling and cause the valve to be distorted from the block seat. Often one valve design will work better in a particular engine than any other, as the location of the hottest spot of the valve can be controlled by design.

Progress is being made in valve development work. This is proceeding along two lines, namely, to improve performance of steels now known, and to develop other steels. No one steel has all the requirements of a perfect valve steel, although these requirements can be found individually in different steels. The steel most nearly meeting all these requirements is silcrome, and it is the most widely used exhaust valve steel. Much metallurgical study is being given to forging methods, grain structure, and heat treatment to improve valve quality, and with good results. Every type of valve failure imaginable is returned to the valve maker, and over a period of time invaluable data is collected. This is particularly true in aircraft work, where each failure is carefully studied.

(Continued on page 86)

Recent Developments in Stationary Spray Systems in West Virginia[1]

By F. D. Cornell, Jr.[2]

DURING the summer of 1928 a study was made of all stationary spray plants in West Virginia with the object of obtaining from the owners information relative to the installation and operation of the systems. These data together with cost figures on the operation of these systems for the 1929 season as well as cost figures for this same period on orchards equipped with portable sprayers were published as West Virginia Agricultural Experiment Station Bulletin 239.

Records of the costs of spraying were kept on several of these same orchards during the 1930 and 1931 seasons, thus making available cost figures covering a three-year period. In addition, owners of stationary systems were visited again during the summer of 1932 for the purpose of obtaining whatever new conclusions they might have reached with regard to the management and operation of the plants after longer experience with them. A few marked changes had taken place.

At the time of the first survey, the pumps were operated under about 400 lb pressure. At present owners of stationary systems are using much higher pressures, in most cases about 600 lb. In one instance the system operated under 700 lb pressure. Owners felt that the higher pressures increased the efficiency and effectiveness of the spraying operation as measured by the condition of the trees and the quality of the fruit produced.

Another noticeable change that had taken place was that, instead of using spray guns as practically all did formerly, owners were using three and four-nozzle rods for their spraying. The rods were proving much more satisfactory, especially in spraying the larger trees, because of their increased capacity and greater effective spray drive and coverage.

According to owners, the stationary plant has a decided advantage over the large portable outfit. The stationary system, they feel, has greater flexibility. While the large portable outfit built to operate eight-nozzle rods is excellent for tall trees, its capacity cannot be maintained without waste where the trees are smaller. With the stationary system, anything from the single gun to the eight-nozzle rod may be used depending upon the size of the trees. The output can be maintained merely by increasing or decreasing the number of spray crews, as governed by the capacity of the guns or rods in use.

One change which was indicated by the earlier study had come about in the size of the spray hose used. Owners had practically discontinued the use of ⅜-in hose and were using ½-in or ¾-in hose. The earlier prediction[3] also that the tendency would be away from the use of long leads of hose and large crews seems to have been borne out in practice. Some owners had reduced the length of hose from 250 ft to 125 or 150 ft by installing more laterals, and had reduced the size of the crew from three men to two, and in some instances to one man. In all plants installed within the last two or three years, the shorter leads of hose were used.

The owner of the oldest stationary system in the state, a plant which has been in operation for ten years, says that it is well to plan for the future when installing the stationary system. As the size of the trees increased, he found it necessary to replace many of the old laterals with larger pipe in order to give the desired capacity. The new laterals being installed are all of one-inch pipe, and for large orchards he recommends two-inch mains. This would give capacity to run any type of equipment necessary to spray the large trees. No pipe less than ¾-in is being purchased for replacing pipe in any of the systems at present, and on all recent installations no pipe less than ¾-in is in use. Practically all pipe used in stationary spray system installations in the past two or three years has been copper-bearing galvanized pipe. Black iron pipe was used on all systems installed in the state before 1928.

All pipe lines were still above ground, except where the lines crossed roadways. Most of the soils in orchards in West Virginia are such as to make burying of the entire lines highly impractical, and in many cases impossible.

Very little pipe is now taken up during the winter, as was the case when the first systems were new. Some owners have adopted the practice of filling the lines with a heavy oil emulsion and letting this stand in the pipe for several days before draining the system for winter.

There had been practically no changes in the power units used in the stationary systems since their installation. This was also true of the pumps in use, indicating the light depreciation of spray equipment for stationary use. The pump on the oldest system in the state had been operating for ten years with no major repairs and is apparently good for many more years of efficient service. With pressures of 600 to 700 lb, however, it is essential that pumps be built to give the desired volume and pressure

[1]Published with the approval of the Director, West Virginia Agricultural Experiment Station, as Scientific Paper No 120. Released for first publication in AGRICULTURAL ENGINEERING.

[2]Assistant professor in farm mechanics, West Virginia University. Assoc. Mem. A.S.A.E.

[3]West Virginia Agricultural Experiment Station Bulletin 239.

(Left) Spraying from a stationary spray system in West Virginia. (Right) Spraying from a John Bean portable sprayer in a hillside orchard

at low speeds, if the pump is to give long and satisfactory service.

Many of the central plants have been more conveniently arranged so that one man may handle the work with ease. In one instance all one man has to do in mixing spray materials is to handle a few 5-lb sacks of material and operate a few valves. The tanks are filled through 2-in pipes. Lime sulphur can be measured and run into the tanks by merely opening and closing valves. Stirring of lime is done in a small vat equipped with a mechanical agitator driven from a lineshaft. Lime sulphur after being cooked can be run into the storage vat by merely opening a valve. All such items contribute to greater efficiency at the central station and insure fewer delays.

The majority of owners of stationary spray plants were very well satisfied with the performance of the units and the work they had been able to accomplish with them. One operator, however, felt that the stationary spray system had decided limitations, particularly in the matter of spraying trees more than 25 ft in height. Other points which he felt might be listed as disadvantages were wastage of spray materials in cleaning out the lines, and difficulties due to freezing in the lines. To overcome this latter trouble this orchardist had installed an air compressor with which to blow out the lines and thus to insure more thorough drainage. In general, however, little trouble from freezing was reported.

Records of the spraying operations in the several orchards were kept over the three-year period with the object of being able to present added information as to the comparative costs and details of spraying with stationary and portable equipment. No attempt has been made to draw definite conclusions as to the relative merits of the two methods of spraying. It is felt that information covering a much longer period of time would be necessary before this could properly be done. The data, however, indicate the work done and the cost of its accomplishment with both types of spraying equipment. Because of the comprehensive nature of the figures obtained it seemed inadvisable to include them in this report[1]. The data, however, revealed some interesting points relative to the methods of spraying under consideration. The number of sprays each season varied, and since not all sprays were applied to all trees, figures on the quantities of spray materials used for each tree were not available for all orchards. Where figures were available, however, the quantities ranged from 3.4 to 8.4 gal per tree over the three-year period in orchards equipped with stationary spray systems. Figures for quantities applied per tree per spray for portable equipment over the three-year period ranged from 2.3 to 11.7 gal. If the one orchardist using such large quantities per tree were eliminated, the range of the other nine orchards over the three-year period was from 2.3 to 7.2 gal per tree per spray. These figures indicate to some extent the thoroughness of the spray application. They are merely an index, however, since variable factors such as the age and size of the trees must be taken into account. The quantities of materials applied per tree per season for all sprays ranged from 19.8 to 47.8 gal in orchards where stationary systems were used. For nine orchards using portable equipment the range was from 12.5 to 43.3 gal per tree for all sprays per season.

One of the best measures of the efficiency of spraying equipment is the quantity of spray materials applied per man-hour. There was considerable variation in the quantities applied per man-hour of labor from stationary plants, the figures ranging from 45 to 166 gal. In spite of this wide variation, these figures were somewhat higher than those showing quantities of spray materials applied per man-hour from portable sprayers. With portable equipment these quantities ranged from 25 to 109 gal per man-hour. However, the great spread in the quantities of spray materials applied per man-hour with both types of equipment indicated the possibilities for improvement in the efficiency of the spraying operation through improved equipment and management.

In computing the costs of spraying, all factors were taken into consideration including labor, costs of spray materials, machine expense, and depreciation. Although labor costs varied with different localities somewhat, the cost figures give a picture of the costs of spraying with the different types of equipment. With the stationary systems, the cost of spraying per tree per season ranged from 18 to 60 cents. This variation may be partially accounted for, of course, by the variation in the quantities of spray materials applied per tree. In the case of the portable spray equipment the costs of spraying per tree per season ranged from 19 cents to $1.12. In the case of the orchardist having the cost of $1.12, however, the average application of spray materials per tree was exceptionally high. It can hardly be assumed that the variation in the quantities of materials applied per tree per spray can be entirely attributed to differences in the size of the trees. Much of this difference will have to be charged to variations in the thoroughness of the spray application.

The figures as obtained over the three-year period on the several orchards do not indicate any marked superiority of one type of spraying over the other in so far as costs of spraying are concerned. What advantages there are, seem to be with the stationary system, but they are hardly great enough to be significant.

[1]Complete tables showing costs and spraying operations on five orchards equipped with stationary systems and on ten orchards sprayed from portable sprayers are available upon request to the West Virginia Agricultural Experiment Station, Morgantown, West Virginia.

A Bulletin Display and Storage Rack

By C. L. Hamilton[1]

EVERY county agent and vocational agricultural teacher needs a good bulletin rack to store and display the numerous bulletins that farmers need to guide them in their farming operations. During the past two years I have made notes on all the bulletin racks used by the county agents in North Dakota, as I visited the various counties to assist with the promotion of agricultural-engineering projects. Information was collected on both the good and undesirable features, and an endeavor was then made to design a rack that provided as many of the desirable features as possible.

The rack I finally designed and built is 6 by 2 by 7 feet and has 132 vertical display pockets and 110 horizontal storage pockets for the standard 6-by-9-inch bulletins. The same design, however, could be used for either smaller or larger racks, and it could be built with or without the storage pockets. Each display pocket is 1¼ inches deep and will hold from 20 to 25 ordinary bulletins. The pockets are constructed so they show a full two-thirds of the cover page of each of the various kinds of bulletins. A narrow metal retainer on each side of the pocket holds the display bulletins in an upright position. Additional storage bulletins can be sorted out and placed in the proper storage pocket directly back of each display pocket. With the shallow display pockets and the separate storage pockets arranged this way, the display and stored bulletins can be kept in an orderly manner at all times. When filled this rack will hold 3520 to 8800 bulletins.

The rack is easy to construct, and when finished with fir and properly stained and varnished it makes an attractive piece of furniture. The bulletins can be placed in rows according to subject matter.

Detail construction plans can be secured for 20 cents from the Agricultural Engineering Department, North Dakota Agricultural College, Fargo, North Dakota.

[1]Extension agricultural engineer, North Dakota Agricultural College. Jun. A.S.A.E.

Agricultural Engineering Digest

A review of current literature on agricultural engineering by R. W. Trullinger, specialist in agricultural engineering, Office of Experiment Stations, U. S. Department of Agriculture. Requests for copies of publications abstracted should be addressed direct to the publisher.

Studies of the Action of Sulphates on Portland Cement.—IV, The Action of Sulphate Solutions on Mortars Prepared from Some Binary and Ternary Compounds of Lime, Silica, Alumina, and Iron, T. Thorvaldson, D. Wolochow, and V. A. Vigfusson (Canadian Journal of Research (Ottawa), 6 (1932), No 5, pp 485-517, figs 8).—Studies conducted at the University of Saskatchewan in cooperation with the National Research Council of Canada on the action of solutions of the sulfates of magesium, sodium, and calcium on 1 : 10 mortar prisms are reported (E. S. R., 62, p 568).

The prisms were made with standard sand and the following substances or mixtures of these: Tricalcium silicate, β-dicalcium silicate, γ-dicalcium silicate, tricalcium aluminate, $5CaO.3Al_2O_3$, monocalcium aluminate, $3CaO.5Al_2O_3$, dicalcium ferrite and $4CaO.Al_2O_3.Fe_2O_3$. Some of the experiments dealt with mortars of richer mix (1 : 7.5 and 1 : 5). The effect of the solution was determined by measuring the linear expansion of the prisms and the tensile strength when the measurements of expansion were discontinued. A very pronounced difference was found to exist between the behavior of mortars made with mixtures rich in tricalcium silicate and those rich in β-dicalcium silicate. This observation is applied in the detailed discussion of the resistance of the different types of hydraulic cements to the action of sulfate solutions.

Walnut Dehydraters: Characteristics, Heat Sources, and Relative Costs, P. F. Nichols, B. D. Moses, and D. S. Glenn (California Experiment Station (Berkeley) Bulletin 531 (1932), pp 34, fig 15).—Two studies of thermal efficiency and comparative cost factors in five types of walnut-dehydrating plants are reported, which were conducted by the station in cooperation with the California Committee on the Relation of Electricity to Agriculture.

The total operating costs for all tests averaged $3.43 per dried ton. They averaged $2.23 in gas-heated plants, $3.04 in oil-heated plants, and $4.86 in electrically heated plants. The overhead costs for all tests adjusted to normal operating capacity averaged $3.61 per dried ton. They averaged $3.44 in gas-heated plants, $3.47 in electrically heated plants, and $4.57 in oil-heated plants. The total costs for all tests averaged $7.15 per dried ton. They averaged $5.89, $7.61, and $8.33 in gas, oil, and electrically heated plants, respectively.

The thermal efficiencies averaged lowest in gas-heated and highest in electrically heated plants. They also averaged highest in plants using recirculation of air. Electric heat, in spite of its high efficiency, proved the most costly, although not so expensive as to be prohibitive in walnut dehydration where low energy rates may be obtained.

The moisture content of the dried nuts varied excessively. No satisfactory means for controlling this automatically have been developed, but possible means of control have been suggested.

The investment in dehydraters, exclusive of buildings, mechanical hullers, washers, and other accessory equipment, was found to vary from $750 to $2,000 per dry ton average daily capacity.

Annual Report of the Department of Water Supplies and Sewage Disposal for the Year Ending June 30, 1931, W. Rudolfs (New Jersey Experiment Station (New Brunswick) Bul. 529 (1932), pp 64, figs 19).—This report presents the progress of studies on Performance of Experimental Trickling Filters during Winter and Summer, by Rudolfs, N. S. Chamberlin, and H. Heukelekian (pp 4-16); Common Protozoa in Filter Beds, by Rudolfs (pp 16-19); Biochemical Changes and Loss of Nitrogen During Prolonged Aeration of Sewage, by Heukelekian and Chamberlin (pp 20-31); Effect of Narrowing the Carbon-Nitrogen Ratio on Sludge Digestion, by Rudolfs and L. R. Setter (pp 31-37); Effect of Trade Wastes on Thermophilic Sludge Digestion; I, Comparison of the Digestion of Trenton (Containing Pickling Liquor Wastes) and Plainfield Solids (Domestic), by Heukelekian (pp 37-41); Effect of Indole and Skatole on Digestion, by Rudolfs and Chamberlin (pp 41-45); Digestion of Activated Sludge Mixed with Fine Screenings, by Rudolfs and I. O. Lacy (pp 45-48); Distribution of Solids in a Digestion Tank, by Rudolfs and C. N. Henderson (pp 48, 49); Studies on the Protozoan Fauna of Sewage Disposal: I, Comparison of Plants, by J. B. Lackey (pp 49 54); and Note on Effect of Chlorine on Bacteria in Sludge, by Rudolfs (pp 54-56).

An abstract section, lists of references and publication, and a list of staff members are also included.

The New Jersey Collapsible Summer Shelter, L. M. Black (New Jersey Experiment Station (New Brunswick) Hints to Poultrymen, 20 (1932), No 9, pp 4, figs 6).—This shelter is described and illustrated. This is the last of this series of publications.

[Agricultural Engineering Investigations at the Indiana Station] (Indiana Experiment Station (Lafayette, Ind.) Rpt. 1931, pp 6-9, 38-40, fig 3).—The progress results are presented on studies of mechanical corn production, a new belt transmission dynamometer, a hot-air drying machine, drying corn in the crib, the combined harvester-thresher, soil erosion, apple storage, poultry house heating and ventilation, threshing with electric power, use of electric current in brooding chicks, power consumption in stationary method of spraying, ovens used for domestic cooking purposes, and kitchen arrangements.

The Theory and Practice of Modern Framed Structures.—Part II, Statically Indeterminate Structures and Secondary Stresses, J. B. Johnson, C. W. Bryan, and F. E. Turneaure (New York; John Wiley & Sons; London: Chapman & Hall, 1929, 10. ed., rev., pt 2, pp XVIII + 590, figs. 346).—This is part 2 of the tenth edition of this handbook, revised and rewritten by Turneaure and W. S. Kinne. It deals with statically indeterminate structures and secondary stresses. It contains chapters on continuous girders, swing bridges, cantilever bridges, arch bridges, suspension bridges, miscellaneous problems in statically indeterminate structures, secondary stresses, and analysis of quadrangular frames and secondary stresses by the method of slope and deflection.

A Textbook on Roofs and Bridges.—Part II, Graphic Statics, M. Merriman and H. S. Jacoby, rev. by E. E. Ebling (New York: John Wiley & Sons; London: Chapman & Hall, 1932, 5. ed., rev., pt 2, pp X + 228, figs [140]).—This is part 2 of the fifth revised edition of this book. It deals with graphic statics and contains chapters on principles and methods, roof trusses, highway bridge trusses, railway girders and trusses, railway trusses with broken chords, miscellaneous structures, elastic deformation of trusses, influence lines for stresses, and deflection influence lines.

Irrigation Canal Structures, R. H. Roberts (Rhodesia Agricultural Journal (Salisbury) 28 (1931), No 3, pp 249-261, figs 5).—General descriptions are given of the structures required on irrigation systems of moderate size, which are most common in Southern Rhodesia. These include intake works, sluice gates, spillways, flumes, inverted siphons, gaging weirs and notches, road crossings, and drops.

Standard Symbols and Glossary for Hydraulics and Irrigation, compiled by D. C. Henny et al. (American Society of Civil Engineers (New York, N. Y.) Proc., 58 (1932), No 5, pt 1, pp 729-755).—This set of standard symbols and glossary of terms used in irrigation hydraulics has been prepared by a special committee on irrigation hydraulics to correct differences of opinion regarding the definition and interpretation of certain commonly used terms.

Adjustment of Automotive Carburetors for Economy, S. H. Graf and G. W. Gleeson (Oregon Agricultural College (Corvallis) Engin. Expt. Sta. Circ. 2 (1930), pp 40, figs 16).—This publication points out some of the factors that affect the economical operation of automotive engines and presents data in support of a more scientific method of carburetor adjustment by the application of the analysis of the exhaust gases and the use of much analyses as a criterion of the economy of operation of an internal-combustion engine.

The studies indicate an average possible saving of motor fuel of 27.7 per cent for passenger cars and 22.3 per cent for trucks as the result of proper carburetor adjustment. The figures as calculated from the principles of combustion of the constituents of a motor fuel agree very closely with the figures obtained under conditions of maximum economy.

The method of procedure for exhaust-gas analysis and carburetor adjustment is described, as well as the instruments used in this connection. The road test procedure as carried on in the study also is described, and the method of making carburetor adjustments by the use of the anaylsis of the exhaust gases is given.

The danger of poisoning from carbon monoxide is treated briefly.

The Theory of the Coldframe, G. W. Todd (Univ. Durham Phil. Soc. Proc., 8 (1931-32), No 5, pp 390-409, fig 8).—The object of this paper is to develop a mathematical expression of the relation between uncovered soil temperature and glass-covered soil temperature in terms of the radiation incident on the earth's surface and to calculate from it the temperature likely to be attained in a coldframe or unheated greenhouse. The statement is made that the method developed can be used to test the relative value of other transparent materials when used as greenhouse coverings.

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Raymond Olney, Editor

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An Engineer's Views on "Economic Balance" as Applied to Agriculture[1]

THE STATEMENT is made that our national prosperity need not depend upon the export of a substantial part of our total manufactures. In the first place, it does not take a very large per cent of our products, either farm or manufactured, to produce a surplus and materially affect prices. An examination of our export position in such products as pork and wheat will clearly show that present surpluses and low prices can be traced, in a large measure, to the falling off of exports.

It is not logical that the various sections of the world should devote themselves to the producing of crops for which some other section is far better fitted. For example, cotton can be produced more cheaply in the cotton belt of the United States than anywhere else in the world. The word "cheap" is meant to include not only the actual expenditure of human and other energy, but unless a system of national slavery is encountered, or a substantial government subsidy is provided, cotton cannot be produced elsewhere to compete with the cotton growers of this country. In like manner, our corn belt is unequaled anywhere else in the world. It is naturally adapted to the producing of corn and pork.

I believe that some of the very foundations on which tariffs are built should be studied from an engineering standpoint. My first-hand observations of the efficiency of wheat production in several of the large wheat-producing areas of the world indicate that, where given identical machinery, similar soil, contour, and weather conditions, labor and management produces wheat practically directly in proportion with its real wages. In other words, low-priced labor, with modern machines methods, cannot compete with American farmers with their many years of experience in the operating and management of machine production.

* * * * *

It would appear as though the increase in the number of men employed in distribution as compared to production might be taken as an indication of inefficiency in distribution. While many of the practices brought about by intensive competition might not be considered economic from the consumers' standpoint, there is one very logical reason why more men should be engaged in selling. Real selling is a service to the consumer. During the last twenty years there has been a tremendous increase in the variety and complication of manufactured articles made available to the buying public. Whereas in the past the buyer chose from a relatively limited variety of articles concerning which he had considerable knowledge, today he chooses from articles of considerable complication concerning the fitness of which for his needs he is seldom capable of intelligently judging. This is calling for more and better trained men in the field of distribution.

In my opinion, this need for better trained men in selling will be one of the great reservoirs for our present unemployed. A secondary reservoir will be the need for instructors in the adult education movement.

* * * * *

The production of farm crops per capita in the United States has been decreasing since 1915. Following is a quotation from Dr. G. F. Warren of Cornell University:

"For 75 years before the war, the production of food and feed crops in the United States increased at the compound rate of 3.02 per cent per year. From 1915 to 1929, it increased only 0.6 per cent per year. If correction is made for the reduced number of horses and mules, the rate of increase is 1.17 per cent per year. We have had surpluses and shortages of some crops owing to the weather, but there is no evidence of general overproduction.

"Total production of all commodities per capita in the United States increased for 75 years before the war at the rate of 1.73 per cent per year, but from 1915 to 1929 it increased only 0.64 per cent.

"For 75 years before the war, world physical volume of production of all basic commodities rose 3.15 per cent per year. Since 1915 the rate has been distinctly less. Instead of the phenomenal increase in output which is popularly imagined, the rate of increase in output has declined. Stocks are in some cases piling up because of unemployment, but these are results of the depression rather than its cause."

The war did cause a considerable increase in acreage due to the reward of high prices and to mechanization, which allowed wheat to be grown in areas of very limited rainfall. However, production per acre has not increased in general in the United States. If anything, the yield per acre has tended to decrease on many of our principal crops, such as wheat, corn oats, flax seed, and tobacco. It may be expected to decrease much further unless farm prices materially improve owing to the fact that the use of fertilizers, disease control materials, better weed control, and the like, cannot be practiced at low prices. Surpluses have not been due so much to increases in the crop volume per capita, but more to lack of consumption and lack of exports.

A somewhat larger proportion of the agricultural production goes into non-stomach uses than is generally supposed. Fiber crops, such as cotton and wool; tobacco; oils, such as flax seed; by-products of milk, such as casiene; soybean oil in soaps and paints, are but a few examples of non-stomach crops. In addition, the nation's ability to very materially increase the consumption of farm crops is brought about whenever there is even a slight shift from the eating of cereals and vegetables to the consumption of meats. A man living on beef alone would consume the produce of around sixteen times as many acres as though he lived on wheat alone.

* * * * *

With reference to agriculture as a business, there are a number of factors which should be considered. Agriculture in general, is suffering from the burden of carrying high land values. Agriculture is about the only industry which has deliberately inflated or increased the value or investment in the producing plant; while other businesses have endeavored to reduce their plant valuation not only

[1]Excerpts from comments on the second progress report of the Engineers' Committee on Economic Balance to American Engineering Council.

in original location and construction, but also through rapid depreciation in their annual statements. On the other hand, the farmer seems to think that it was to his advantage to write up his net worth whenever he had an excuse to do so. This focused attention upon land values and had an effect on the amount of taxes imposed. It is generally stated that the price of land in the corn belt increased from 2 to 3 per cent a year for some 50 years up to 1921. Farmers could lose money every year from the standpoint of cost of production and selling price of crops, but if they owned their farm, they could retire and live on their "earnings."

Agriculture has been particularly hurt by the loss of exports. Prices have been affected by the holding of crops off the market rather than through quick liquidation. The holding of crops has held up the promise of high sustained prices which has encouraged inefficient producers to stay in the business. Agriculture is also burdened by the fact that, more than any other industry, there is a wider range between the production cost of the efficient and inefficient producer. The efficient producer in agriculture, however, is not allowed to materially expand his activities, such as the automobile or machinery manufacturer and thus completely force out the less efficient competitor. It may be that at some future time large farming corporations may develop, but under present capitalization requirements and managerial difficulties, these large corporations cannot compete with the better class of family-operated farms. There is, however, a definite trend toward a larger size of family farm which allows considerable economies in production.

Another fact concerning agriculture worthy of note is that the price level of farm products has been below par, so to speak, since 1921. The fact that agriculture maintained its position for about 10 years shows the extreme vitality of this industry and its ability to withstand the continual drain. For a number of years the business men in this country felt that agriculture could permanently withstand this differential. At the same time, it is fallacious to use the old argument that 100 bushels of wheat will buy but one-third or one-fourth as much today as formerly, for the reason that the cost of producing this bushel of wheat has, in itself, been reduced. However, the reduction in farm cost of the wheat is not as much as its reduction in buying power today.

As a general statement, agriculture cannot now furnish the labor reservoir to take up the slack from industry. Agriculture must have buying power to maintain prosperity for all classes. This buying power will be destroyed if agriculture is overcrowded. Subsistence farming is not possible unless we are willing to destroy practically everything that we call now desirable in our present civilization. Farmers must be able to pay taxes and to purchase clothing and other necessary manufactured products which they are not now capable of producing. If agriculture goes back to complete self-sufficiency, there will be a gradual but sure decay of our transportation, manufacturing, educational, publishing institutions, in fact, every great phase of industry or national activity. No nation will prosper unless the people on the land produce more than they need for their own consumption. All we have to do is to intelligently study Chinese agricultural economy to see the proof of this statement.

Even though a person will not agree with the foregoing, agriculture today is entirely too complicated to allow the entrance of very many of the people now unemployed in the cities. Modern agriculture demands a knowledge of the management and operation of machinery; the ability to handle livestock, plant and cultivate a variety of crops, and control an every-increasing variety of plant and animal diseases. That this knowledge is required and also used may be illustrated by the following statement taken from the address of Dr. C. W. Warburton of the U. S. Department of Agriculture before the recent annual meeting of the American Farm Bureau Federation:

"Iowa's swine industry provides a striking example of the increased efficiency and economy of livestock production resulting from the application of extension recommendations that ought not to be allowed to deteriorate in the face of present conditions. Because of the increase in the average number of pigs per sow raised to the weaning age in Iowa in 1931, as compared with the average for 1923, the state required half a million fewer sows to produce the 1931 hog crop than were required to produce a crop of the same size in 1923. This means that the Iowa sows are one-third more efficient than they were nine years ago, because of improvement in sanitation, feeding, and management."

In brief, agriculture must be treated exactly as any other manufacturing industry in the United States and is amenable to the same economic laws. Mechanization is bringing to agriculture a shortening of hours which is one of the logical ways out for industry's problem, namely, the shorter working day for labor. This is not new as may be pointed out, but has been the effect of the machine since the industrial revolution of 1800.

* * * * *

There is nothing new in the present situation. We have over a century of experience to draw upon. Engineering developments have always tended toward relieving the laborer from long hours of most difficult tasks and has brought higher standards of living to those nations which will take advantage of its opportunities. The engineering profession could do much to instill confidence in American people rather than let its parasitic appendage, "technocracy," occupy the front page. I do not recommend here an attack on technocracy, which, for the time at least, would only tend to further its cause. I would recommend a complete ignoring of the word itself, but continue to point out how technological, or engineering developments, is insuring a happy future for the people of this nation and the world.

Leonard J. Fletcher[1]

Good Cooperators

ALL members of the American Society of Agricultural Engineers deserve to know of a recent fine commendation of the Committee on Relations with Vocational Agricultural Education and of the college agricultural engineering departments.

It is the substance of a letter written for the Federal Board for Vocational Education by J. A. Linke to M. A. Sharpe, chairman of the above-mentioned committee. It praises the work of the committee and the cooperation agricultural-engineering departments have shown in providing specially adapted courses for teacher training. Mr. Linke said in part:

". . . . . of the divisions in agricultural colleges which are changing their courses to function in the training of teachers, the departments of agricultural engineering are doing more than any other technical departments in the agricultural colleges in the adapting of their courses for the training of vocational teachers.

"Dr. L. E. Jackson, at Ohio State University, made a study of the changes in technical courses in the North Central Region, and found that of all the technical courses changed to meet the needs of vocational teachers, two-thirds of these courses occurred in agricultural engineering. This is a splendid showing for the agricultural engineers and we ascribe the progress made by them to the fact that we have a special committee working on these courses in the North Central Region. I want to compliment you and your committee on the splendid work which it has been doing."

Good work, Mr. Sharp, Committee on Relations with Vocational Agricultural Education, and cooperating agricultural engineering departments! We add our compliments to those of Mr. Linke and the Federal Board for Vocational Education.

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[1]Agricultural engineer, Caterpillar Tractor Co. A.S.A.E. representative on American Engineering Council. Mem. A.S.A.E.

A.S.A.E. and Related Activities

Nominations of A.S.A.E. Officers

THE list of candidates for the annual election of officers of the American Society of Agricultural Engineers has been reported by the Nominating Committee, consisting of S. H. McCrory (chairman), L. W. Chase, and F. C. Fenton. The election will be held this spring, and the newly elected officers will begin their terms of service with the close of the annual meeting in June.

The by-laws of the Society provide that thirty days shall be allowed for additional nominations by special nominating committees, if they so desire. At the expiration of this period (on April 10) the Secretary of the Society will mail letter ballots to all voting members.

The following is the list of candidates placed in nomination by the Nominating Committee:

FOR PRESIDENT

Arthur Huntington, public relations engineer, Iowa Electric Light and Power Company.

FOR FIRST VICE-PRESIDENT

Rudolph H. Driftmier, professor of agricultural engineering, University of Georgia.

Mark L. Nichols, professor of agricultural engineering, Alabama Polytechnic Institute.

FOR SECOND VICE-PRESIDENT

Max E. Cook, farmstead engineer, Pacific Lumber Company.

Karl J. T. Ekblaw, agricultural engineer, American Zinc Institute.

FOR TREASURER

Raymond Olney, secretary of the Society.

FOR COUNCILOR

Elmer E. Brackett, professor of agricultural engineering, University of Nebraska.

Wallace F. MacGregor, mechanical engineer, J. I. Case Company.

FOR NOMINATING COMMITTEE

Wm. Aitkenhead, professor of agricultural engineering, Purdue University.

D. G. Carter, professor of agricultural engineering, University of Arkansas.

W. G. Kaiser, agricultural engineer, Portland Cement Association.

J. A. King, publicity manager, Mason City Brick & Tile Company.

E. W. Lehmann, professor of agricultural engineering, University of Illinois.

S. P. Lyle, senior agricultural engineer, Bureau of Agricultural Engineering, U. S. Department of Agriculture.

O. W. Sjogren, agricultural research engineer, Killefer Manufacturing Corporation.

F. A. Wirt, advertising manager, J. I. Case Company.

German Agricultural Engineers Organize

OF INTEREST to the members of the American Society of Agricultural Engineers is the recent organization of agricultural engineers in Germany, a brief account of which is contained in a letter from Dr. C. H. Dencker (Mem. A.S.A.E.), head of the department of agricultural engineering at the agricultural college in Berlin, to R. B. Gray (Mem. A.S.A.E.) chief, division of mechanical equipment, U.S.D.A. Bureau of Agricultural Engineering, as follows:

"At the meeting on February 2 of the Deutschen Landwirtschafts-Gesellschaft, the organizing of a German society of agricultural engineers is to take place. You know that there was in Germany an organization of agricultural experiment stations which corresponded in a limited degree to the A.S.A.E. This organization incidentally also celebrated in 1931 its 25th birthday, as you have read in our journals. After my return from the United States, enthused by the glowing standards of A.SA.E., I started a reorganization of our V. L. M. P. A. (Verband der Landwirtschaftlichen Maschinen-Prufungs-Anstalten) so that in the future not only professors of agricultural machinery and manufacturers' representatives might be included in this society, but also those men working in milk production, dairying, land reclamation, rural electrification, fertilizer industry, etc.

"Our society has in addition to this expansion changed its name to 'Max Eyth Gesellschaft,' in honor of Max Eyth, the great pioneer in German and English agriculture. In Europe, outside of Germany, the field of agricultural engineering is not scientifically treated, so that the Max Eyth Gesellschaft initiates a European counterpart of the A.S.A.E. I hope that soon we may be able to count some American agricultural engineers among the membership of this society and that the relationship between the two Societies will closely and fruitfully develop."

Personals of ASAE Members

T. E. Hienton, project leader in rural electrification, Purdue University, is one of the authors of Bulletin No. 363, entitled "Some Factors Affecting Mechanical Refrigeration for Dairy Farms," and Bulletin No. 367, entitled "Experiments with Electric Motor Heaters for Poultry," recently issued by that institution.

O. W. Israelsen, irrigation and drainage engineer, Utah Agricultural Experiment Station, and **W. W. McLaughlin,** chief, division of irrigation, Bureau of Agricultural Engineering, U. S. Department of Agriculture, are joint authors of Bulletin No 242, entitled "Drainage of Land Overlying an Artesian Ground-Motor Reservoir," a progress report recently issued by the Utah Agricultural Experiment Station, Logan.

New ASAE Members

W. E. Ayres, assistant director (in charge), Delta Experiment Station, Stoneville, Miss.

Joseph H. Flanagan, lubricating engineer, Standard Oil Company, 910 South Michigan Ave., Chicago, Ill.

Samuel W. Gray, sales engineer, Wheeler-Schebler Carburetor Co., Flint, Mich.

James Heber Lillard, post graduate student, Virginia Polytechnic Institute. (Mail) Box 319, Blacksburg, Va.

George W. Pickering, sales manager, The Cleveland Tractor Co. (Mail) 1851 Taylor Road, East Cleveland, Ohio.

Arthur H. Senner, mechanical engineer, Bureau of Agricultural Engineering, U. S Department of Agriculture, Washington, D. C.

Clarence F Vogel, Lark, N. Dak.

Applicants for Membership

The following is a list of applicants for membership in the American Society of Agricultural Engineers received since the publication of the February issue of AGRICULTURAL ENGINEERING. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

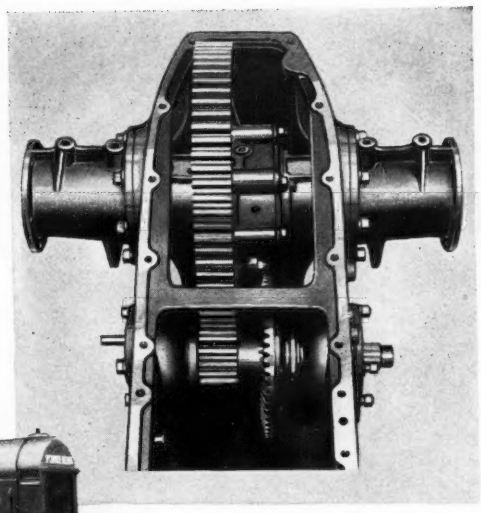
Carl R. Rolen, branch manager, Oliver Farm Equipment Sales Co., Waukesha, Wis.

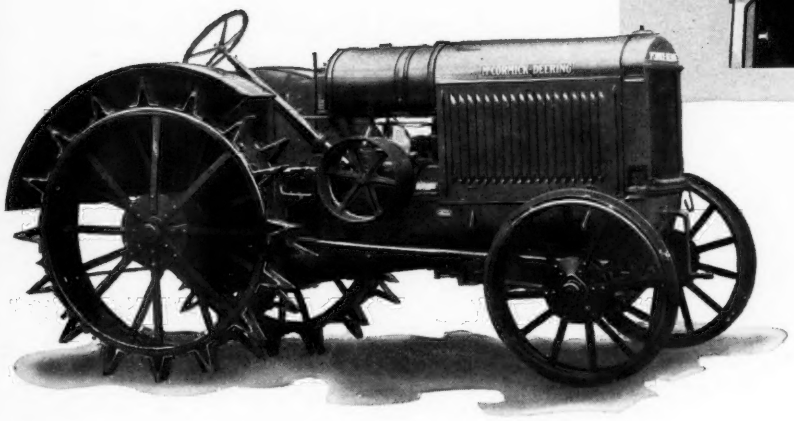
Joseph S. Webb, supervisor, rural sales section, Philadelphia Electric Company, 1000 Chestnut St., Philadelphia, Pa.

Dependable materials are the best assurance of dependable performance

Right: *Nickel Chromium Steel gears in McCormick-Deering tractors.*

Below: *McCormick-Deering farm tractor, mfd. by the INTERNATIONAL HARVESTER CO., Chicago, Ill.*





To maintain their reputation for better performance...greater ruggedness, McCormick-Deering Tractors use NICKEL STEEL PARTS

McCORMICK-DEERING tractors are an important part of a famous line of products manufactured by the International Harvester Company. Both in industrial and agricultural service, these tractors have demonstrated their rugged power, strength and reliability over a long period of time.

Such satisfactory performance depends in large measure upon the use of the highest grade materials, particularly upon the steel used for gears, crankshaft, and other moving engine parts. Nickel Chrome Steel, heat treated to withstand the violent stresses and shocks of tractor service, is used for these parts. Numerous other small parts are made of other Nickel Alloy Steels.

Among the outstanding characteristics of Nickel Alloy Steels are (1) resistance to fatigue and impact; (2) toughness; (3) uniformity; (4) ease of heat treatment. These qualities are resulting in an ever-increasing use of Nickel Steel for vital parts of tractors and other heavy duty machinery and equipment. Our technical staff will gladly advise you concerning the proper type of Nickel Alloy Steel suitable to your structural requirements.

Nickel
ALLOY STEEL
PERFORMS BETTER LONGER

SEND FOR LIST OF AVAILABLE PUBLICATIONS ON NICKEL AND ITS ALLOYS

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL STREET, NEW YORK, N. Y.

Miners, refiners and rollers of Nickel... Sole producers of Monel Metal

"IT IS GOOD BUSINESS TO HAYNES STELLITE PLOW SHARES"

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J. Leo Ahart . . . Agricultural engineer at Boni Agri Farms, Iowa, says:

"After plowing 145 acres of partially frozen ground, tough second-year sweet clover, and soil so hard that no other shares in the neighborhood would stay in the ground, our Haynes Stellited shares have practically their original width and are good for another field or two. The big thing with us is that *the shares stay sharp*, giving superb plow performance and very noticeable fuel economy. It is good business to Haynes Stellite plow shares."

The motion picture, "Haynes Stelliting Plow Shares", will be loaned to interested organizations. Write for details.

HAYNES STELLITE COMPANY

Unit of Union Carbide and Carbon Corporation

UCC

General Office and Works—Kokomo, Indiana

ASAE

Wear The Emblem

Every agricultural engineer who is a member of the American Society of Agricultural Engineers, should wear the official emblem of the Society. It identifies him with the national organization representing his chosen profession; it helps to give him standing in his profession. The price of the official A.S.A.E. emblem with blue background is $2.50, equipped with screw post and button back; or $3.00 equipped with jeweler's safety cach pin. Red background emblems with safety catch pin fastener (worn by Junior, Affiliate and Student members) are available at $1.50.

AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS

Saint Joseph, Michigan

Valve Problems and Recent Developments

(Continued from page 78)

Many failures are not due to the valve itself, other mechanical functions, fuel, and special operating conditions contributing to many valve failures. The thorough data compiled from aircraft work is applied to automobile valves, and the quality of these parts is considerably improved over the last few years. Operating conditions have become worse with higher engine speeds and compression ratios, and it is the program of the valve manufacturer to stay ahead of engine development, so that when improvements are needed in valves, they are ready for the engine builder.

We consider the use of the electric eye a decided improvement in manufacturing. By its use forging temperatures and local treatments are accurately controlled, contributing greatly to a more uniform and improved product.

Exhaustive work has been done toward cooling valves in various ways. Sodium, copper, and air have been used for this purpose. The latest aircraft development is a hollow-head, sodium-cooled valve. A uniform cavity is formed in the valve head, allowing sodium to come nearer the seat and conduct heat away through the guide by convection. This is a very difficult valve to make, but results have been good. Metallic sodium is a good heat conductor, melting at a low temperature and having about the viscosity of kerosene at highest temperatures. It, therefore, splashes readily, cooling the valve head, and in addition has a high boiling point and consequently low vapor pressure in the ordinary valve temperature range.

Stem sizes are usually larger with sodium-cooled valves to allow for drilling. Copper is not used in the larger valve sizes because of weight, but in the smaller sizes it works satisfactorily. Special designs must be made to incorporate air cooling, and this cooling medium is receiving considerable attention, at the present time.

Fuels are receiving increased attention. Some types harm valves considerably more than others. It is thought this is due mainly to the sulphur content, but this is not certain in all cases. We have seen cases of intergranular corrosion and actual forging of the valve seat on the block seat, both directly traceable to fuel. Some fuels are late burning, causing exhaust valves to run hotter. Lean mixtures are particularly hard on valves, causing those containing chromium to have a dry, reddish color, higher temperature, and increased oxidation. Generally speaking, the Btu content of a fuel is the most important factor in determining exhaust gas temperature. The higher the Btu content, the higher the exhaust temperature. The higher the latent heat of the fuel, the lower the exhaust temperature. Exhaust valves will ordinarily operate hotter on low grade fuels, with more gum and corrosion likely. A temperature cycle on a fair grade of gasoline and benzol is as follows:

	Combustion temperature	Expansion stroke	Exhaust temperature
Gasoline	4490 deg	3010 deg	1640 deg
Benzol	4020 deg	2580 deg	1560 deg

High grade fuel will increase output, at the same time relieving some of the gum and corrosion troubles found with poor fuel. Generally speaking, the Btu content of a fuel is the most important factor in determining exhaust temperature. The higher the Btu content of the fuel, the hotter the exhaust temperature. The higher the latent heat, the lower the exhaust temperature. Exhaust valves ordinarily operate hotter on low grade fuels, and in addition gum and corrosion are likely to be worse.

Gasoline of 58 to 60 gravity contains approximately 128,000 Btu per gallon; 44 gravity kerosene, 134,000 Btu, and 38 gravity distillate, 137,000 Btu. Power output will be higher, however, with the higher grade fuel and with higher compression ratios. Economy will be determined by the price of the fuel.

All our automotive test work is done with Ethyl gasoline. We have had no failures directly traceable to this fuel. We do know that Ethyl gasoline is a help in eliminating "pick-up" on valve seats, probably due to the insulation effect of a slight film forming on the valve seat.

I AM A VETERAN OF THE ROAD GANG

8 YEARS . . . 8 tough, gruelling years in a Caterpillar Tractor on Indiana highways . . . and now I'm making good on an Indiana farm. I am an SKF Bearing!

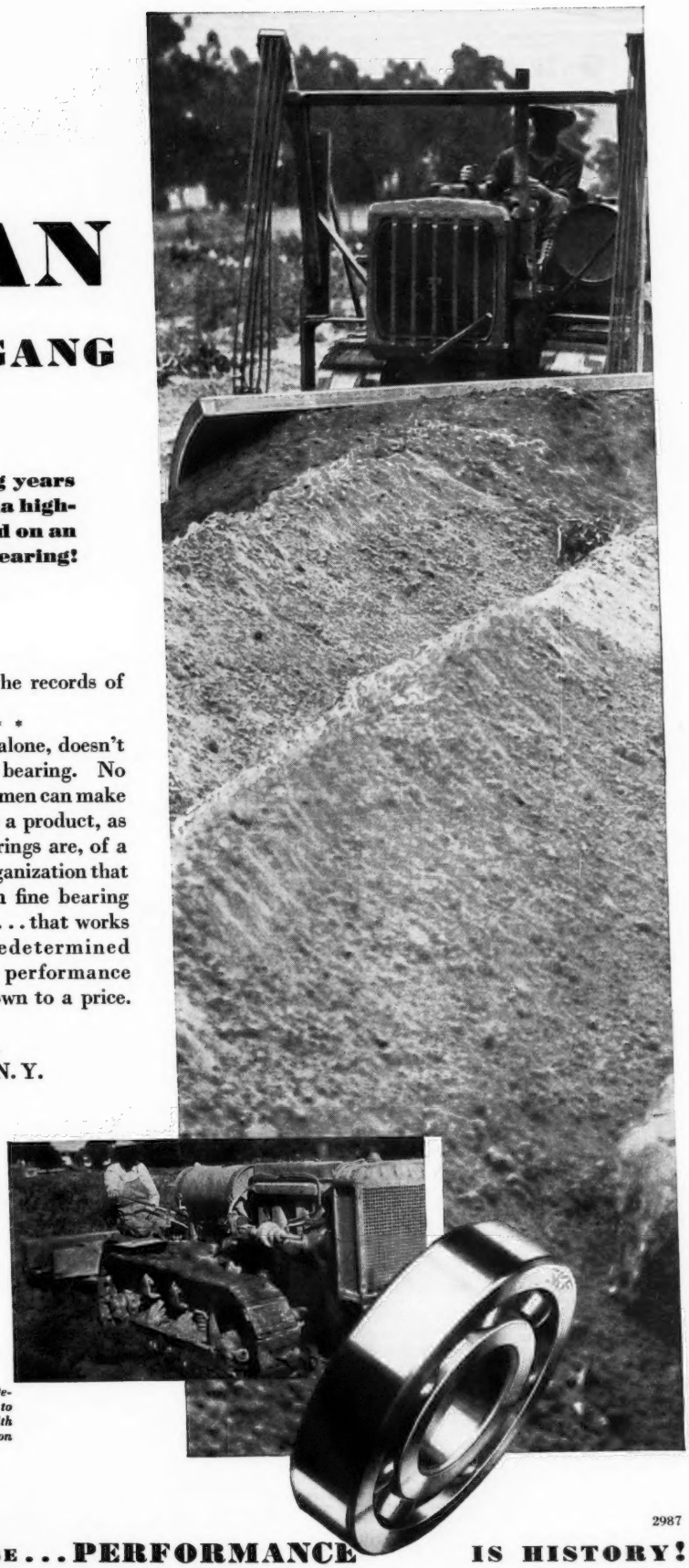
I CARRIED heavy loads in my 8 long years of highway building, without reprieve. Now I've got a job . . . even harder . . . on a Hoosier farmstead.

My strength is based on the special SKF steel that went into me. Gruelling tests in SKF laboratories furnished evidence of the punishment I could stand. The final measure of my stamina is written in the records of my labors.

* * *

Mere steel alone, doesn't make such a bearing. No mere group of men can make it either. It's a product, as all SKF Bearings are, of a world-wide organization that specializes on fine bearing manufacture . . . that works up to a predetermined standard of performance and never down to a price.

SKF INDUSTRIES, Inc.
40 East 34th Street, New York, N. Y.



SKF
BALL & ROLLER BEARINGS

For eight years Marion County (Ind.) Highway Department road crews meted out heavy punishment to this SKF-equipped Caterpillar Tractor. Now, with the same old SKF Bearings, it is making good on an Indiana farm.

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"Galvanized Sheets Protect"

Sound Practice in Roofing Farm Buildings

The roof is the most important part of a barn, or any other farm building, for it protects everything underneath. The best roof is none too good. . . . Good roofing should be strong, attractive, convenient to obtain, easy to put on, fire-proof, lightning-proof (when properly grounded), and durable. . . . . No other material fulfills these requirements so well as

Heavy Coated Galvanized Sheets

The zinc coating on galvanized sheets is their protection against rust. The heavier the zinc coating, the more durable the sheets. . . . On galvanized sheets bearing the "Seal of Quality" shown below, the zinc coating is fully **2 ounces per square foot,** far heavier than the usual commercial coating, and such sheets can be depended upon for long years of satisfactory, rust-free service. Tell your clients to insist that every galvanized sheet they buy bear the "Seal of Quality."

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The American Zinc Institute does not manufacture sheets and has none to sell. Our interest is in the improved quality of galvanized sheets. A list of manufacturers of "Seal of Quality" sheets for roofing and siding will be gladly sent upon request.

EMPLOYMENT BULLETIN

An employment service is conducted by the American Society of Agricultural Engineers for the special benefit of its members. Only Society members in good standing are privileged to insert notices in the "Men Available" section of this bulletin, and to apply for positions advertised in the "Positions Open" section. Non-members as well as members, seeking men to fill positions, for which members of the Society would be logical candidates, are privileged to insert notices in the "Positions Open" section and to be referred to persons listed in the "Men Available" section. Notices in both the "Men Available" and "Positions Open" sections will be inserted for one month only and will thereafter be discontinued, unless additional insertions are requested. Copy for notices must be received at the headquarters of the Society not later than the 20th of the month preceding date of issue. The form of notice should be such that the initial words indicate the classification. There is no charge for this service.

Men Available

AGRICULTURAL ENGINEER, with B. S. degree from Iowa State College in 1915, employed until recently with large sewer pipe manufacturer in Middle West, work consisting of the design, promotion and sale of various clay products, with contact being made largely through engineers and contractors in the Middle West, South and Southeast; special study having been given to sewage disposal, sewer and culvert work, jointing materials for sewer pipe, athletic field and airport drainage; having charge of all sewer pipe tests, and sewer and culvert investigations, and also thoroughly familiar with silo and farm building construction, desires permanent connection where above experience can be utilized if possible. Middle West location desired. Married. Two children. MA-222.

AGRICULTURAL ENGINEER with bachelor's degree in agricultural engineering from the University of Minnesota (1931), desires employment where his training and experience are needed. Was raised on farm and has had experience on different types of farms—grain and livestock, dairy, and western wheat farm. Has operated an artificial forage crop drier. Is experienced in the handling of men, having been field boss on a large farm operated by a canning factory. MA-223.

AGRICULTURAL ENGINEER with bachelor's degree from an engineering college, with one year's experience as research engineer in an engineering college and four years' experience with the Bureau of Agricultural Engineering, U. S. Department of Agriculture, desires position as manager and operator of a large farm, preferably located in the Middle West. 26 years of age. Married. MA-224

DRAFTSMAN AND DESIGNER of full line of farm machinery, with 5 years experience with Moline Plow Co., 4 years with Janesville Plow Co., and 3 years with J. I. Case Co., who has traveled extensively in the United States and Europe in developing farm machinery, desires employment in experimental department of a machinery manufacturer. Good habits. Best of references. MA-225

MANAGER—who was trained under the Danish school system equivalent to the Bachelor of science degree in this country; who has held executive positions for 15 years in large scale agricultural production; whose experience covers farm and plantation management, land appraisals, financial studies, including legal procedure in foreclosures, receiverships, etc., who has ability to handle labor and to adapt himself to surroundings—desires employment preferably along management lines. Speaks Spanish. MA-226.

AGRICULTURAL ENGINEER—with bachelor's degree in agriculture and in agricultural engineering and master's degree in agricultural education from Pennsylvania State College; with twelve years' experience in teaching, research, administration, and extension work in agricultural engineering; with four years' experience in the treasurer's office of The Pennsylvania Railroad; with one year's work with the Land Utilization Survey of the Greater Pennsylvania Council; with special preparation in laboratory and shop methods, visual aids to instruction, agricultural power, sanitation, mapping and land utilization, shop and drawing; and thoroughly familiar with the problems of administration and organization of new courses and projects—desires employment in work for which his training especially fits him. Forty years of age. Married. Two children. MA-227

AGRICULTURAL ENGINEER with several years experience in the educational and agricultural engineering field, and at present employed by a large electric power company as rural service director, will consider a change. Prefers an opportunity with a progressive power company to apply educational methods to development work in rural electrification. Will go anywhere. MA-228

GRADUATE in agricultural engineering from University of Missouri, majoring in land reclamation and land appraisal, desires position with a land holding company. MA-229